Advant® OCS
with Master software

# Advant® Controller 55

## User’s Guide

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| | |
|---|---|
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| **CAUTION** | Hazards which could result in equipment or property damage |
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# Chapter 1 Foreword

## 1.1 Documentation on Advant Controller 55

Documents relevant to Advant Controller 55, including those referred to in this document, are listed below.

*Table 1-1. Advant Controller 55 System*

| Manual | Description |
|---|---|
| PC Elements<br>Advant Controller 55<br>Reference Manual | Data for the PC elements available in Advant Controller 55. |
| Data Base Elements<br>Advant Controller 55<br>Reference Manual | Data for the data base elements available in Advant Controller 55. |
| RCOM<br>Advant Controller 55<br>User's Guide | Describes the Advant Controller 55 equipment and provides information required to install and commission the system. |
| AMPL Configuration<br>Advant Controller 100 Series<br>Reference Manual | Instructions for configuration and application programming, fault tracing and maintenance of Advant Controllers 55, 70 and 110 using an Advant Station 100 Series Engineering Station. |
| AdvaBuild for Windows<br>Function Chart Builder<br>User's Guide | Describes how to program an Advant Controller with the Function Chart Builder |
| AdvaBuild for Windows<br>Application Builder<br>User's Guide | Describes the Application Builder which is used for management of Function Chart Builder projects for Advant Controllers |
| Advant Station 100 Series ES<br>AdvaBuild for Windows<br>Environment User's Guide | Contains a description of the basic functions, its connection and start-up, and how to work with the main functions. |
| Interference-free electronics<br>Design and Applications | A description of the installation rules for the MasterPiece and MasterView families to ensure their correct function in environments where such disturbances are present. |
| ABB Master<br>Environmental Immunity<br>Data sheet | Philosophy, theory, design and applications of EMC on equipment and systems.<br>Valid for all ABB Process Automation systems. Summary of the ABB Master environmental factors. |

# Chapter 2 Introduction

## 2.1 General

Advant Controller 55 (AC 55) is a compact remote terminal unit (RTU) and programmable logic controller (PLC) for control and supervision of processes and equipment in industrial environments.

You can use the Advant Controller 55 as a stand-alone station or as part of an RCOM network. The Advant Controller 55 is specifically designed for high-speed PLC applications. Via RCOM it communicates with an Advant Controller 400 Series, Advant Controller 110, Master Piece 200/1 or AdvaSoft for Windows ( Figure 3-2).

Advant Controller 55 covers a wide range of programmable functions ( Section 3.1, General) and is programmed, using graphic symbols under menu control, by the Advant Station 100 Series Engineering Station (AS 100 ES) (refer to *AdvaBuild for Windows Function Chart Builder User's Guide*).

ABB Master Programming Language (AMPL) is used for application programming (refer to *AMPL Configuration Advant Controller 100 Series Reference Manual*).

Program entry, testing, documentation and fault tracing are supported by Advant Station 100 Series Engineering Station.

The Advant Station 100 Series Engineering Station is an IBM-PC-based programming and service tool featuring graphical function chart programming and a user interface with window techniques, pull-down menus and "point-and-click" selection. Communication with the Advant Controller 55 is accomplished via a standard serial interface in the personal computer.

Advant Controller 55 consists of a compact basic unit, which can be extended in analog and digital I/O by up to four expansion units, up to 170 I/O channels. The units are designed so you can mount them on a wall or on the rear wall in a cabinet.

## 2.2 Purpose of this Manual

This manual is intended primarily for plant designers and commissioning and maintenance personnel. It provides you with information on the Advant Controller 55 system, its design, operation, capabilities and scope.

This manual also contains relevant information about the system hardware. To enter a program, follow the procedure described in *AMPL Configuration Advant Controller 100 Series Reference Manual*.

## 2.3 Contents of this Manual

Chapter 3, System Description contains general information about the Advant Controller 55 and tells you how to assemble the hardware and software to form a system.

Chapter 4, Hardware Description describes the mechanical design of the AC 55 system. It also covers the basic and expansion units’ operation and setting as well as the technical data for the hardware components.

Chapter 5, Hardware Planning and Installation contains hints and rules for selecting and installing the hardware components. It describes the rules for grounding and screening and the routing of process and power cables inside and outside the cabinet.

Chapter 6, Commissioning gives you the procedures to follow to check an Advant Controller 55’s installation (for example, power supply, wiring). It also describes how to start the system and how to connect the Advant Station 100 Series Engineering Station to the Advant Controller 55.

Chapter 7, Fault Tracing describes fault tracing and remedial action in an Advant Controller 55 system. It also describes the error codes and the actions you should take in response.

Chapter 8, Maintenance and Repairs describes preventive maintenance and the replacement of modules.

Chapter 9, Memory Requirements describes how to calculate the memory which an application needs on the CPU.

Chapter 10, Performance describes how to calculate the CPU load of an application.

Chapter 11, Loading of AC 55 System Software describes how to load system software and system software options.

For information on the environmental conditions for an Advant Controller 55 system (climatically, mechanical and electrical environment), see the manual *Interference-free electronics*.

# Chapter 3 System Description

## 3.1 General

Advant Controller 55 is a compact process station with excellent performance for logical control. It offers the following wide range of functions, including analog signal processing.

- Logical operations and time delays
- Sequential control
- Arithmetical operations
- Connection to Advant Controller 400 Series, Advant Controller 110, AdvaSoft for Windows, MasterPiece 200/1, and MasterPiece 40 process stations via RCOM link
- Event handling

You can interconnect several Advant Controller 55 systems via an RCOM link.

The link facilitates the exchange of real-time process data and status information.

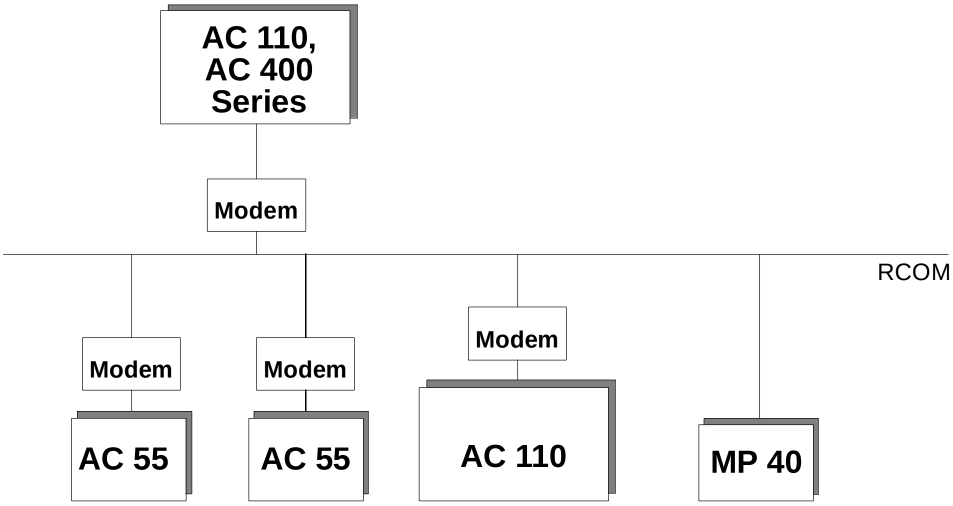


*Figure 3-1. Advant Controller 55 used as Remote Terminal Unit*

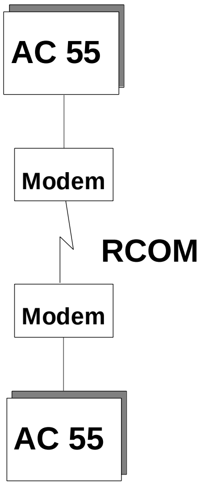


*Figure 3-2. Advant Controller 55 used as a Compact PLC consisting of Two Stations*

## 3.2 Advant Controller 55 Basic Unit

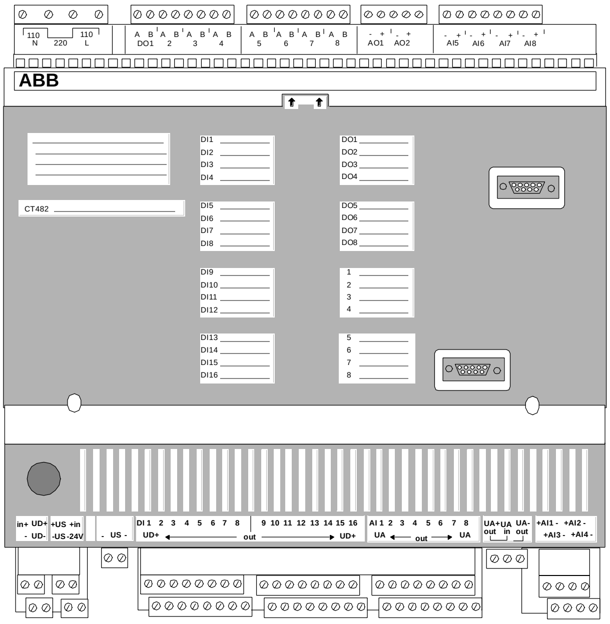


*Figure 3-3. Advant Controller 55 Basic Unit*

The Advant Controller 55 basic unit is based on a high-performance 16-/32-bit Motorola microprocessor. The system software is stored in Flash EPROM on the basic unit.

The Advant Controller 55 system software includes a real-time operating system, a PC element library, diagnostic functions and interfaces for the Advant Station 100 Series ES and RCOM link.

The application program is stored in a nonvolatile memory (Flash EPROM) in the central processing unit. At power-up, the application program is transferred from the nonvolatile memory and runs from RAM.

The application program consists of a PC program (PCPGM) and up to 31 subordinated program modules or execution units (CONTRM or SEQ). They are executed cyclically with cycle times which you can set in a range from 2 milliseconds to 20 seconds.

Diagnostic functions monitor system operation and report any faults detected. The monitoring functions include a watchdog, bus supervision, memory checks and monitoring of the power supply and process voltages.

Faults are indicated on the central processing unit's diagnostic display LEDs. You can obtain more detailed diagnostic information by connecting the Advant Station 100 Series Engineering Station to the central processing unit.

There are two serial interfaces on the central processing unit. The first one is used to connect the Advant Station 100 Series ES programming tool unit. The second is used for exchanging data via RCOM link, with or without an external modem.

The central processing unit includes a real-time clock and calendar. An internal condenser serves as the standby supply for the clock and calendar circuit and for the RAM used to store variables and other application data for up to one day without power supply.

You can select the program starting sequence after a power failure, and you can choose different initialization modes.

### 3.2.1 ABB Master Programming Language (AMPL)

Application programs are written in the high-level ABB Master Programming Language (AMPL), a function block language which presents the basic functions as function elements with inputs and outputs. The function element library includes an extensive set of elements ranging from a simple AND to analog signal processing.

The inputs and outputs of the function elements are connected to the inputs and outputs of other elements or to the process I/Os. These interconnections are determined by the programming.

Programming is supported by the graphical editors of the Advant Station 100 Series Engineering Station.

There are two kinds of function elements:

- PC elements (elements of a process control program; a PC program)
- DB elements (data base elements).

The PC elements are the building blocks for constructing a PC program. The PC element library includes the processing functions as well as elements for structuring the program in modules, for example, CONTRM.

The order of execution and cycle times of the program modules are specified by these structure elements.

You use the DB elements to define the input and output signals, that is, the external interface of the PC program. Use the DB elements to specify the process I/O signals as well as signals which are exchanged via an RCOM communication link. Most DB elements provide diagnostic and status information in addition to I/O signals.

DB elements are also used to define the addresses and the configuration parameters of the I/O.

Figure 3-4 shows an example of a simple Advant Controller 55 application program. The I/O signals are connected to the I/O channels which are represented by the DB elements DI 1.1, DI 1.2, DI 1.3 and DO 1.1. The PC program accesses the I/O signals via the DB elements. In the PC program, signals can be represented either by their symbolic name or by the DB element item designation.

For further information, refer to the *AMPL Configuration Advant Controller 100 Series Reference Manual.*

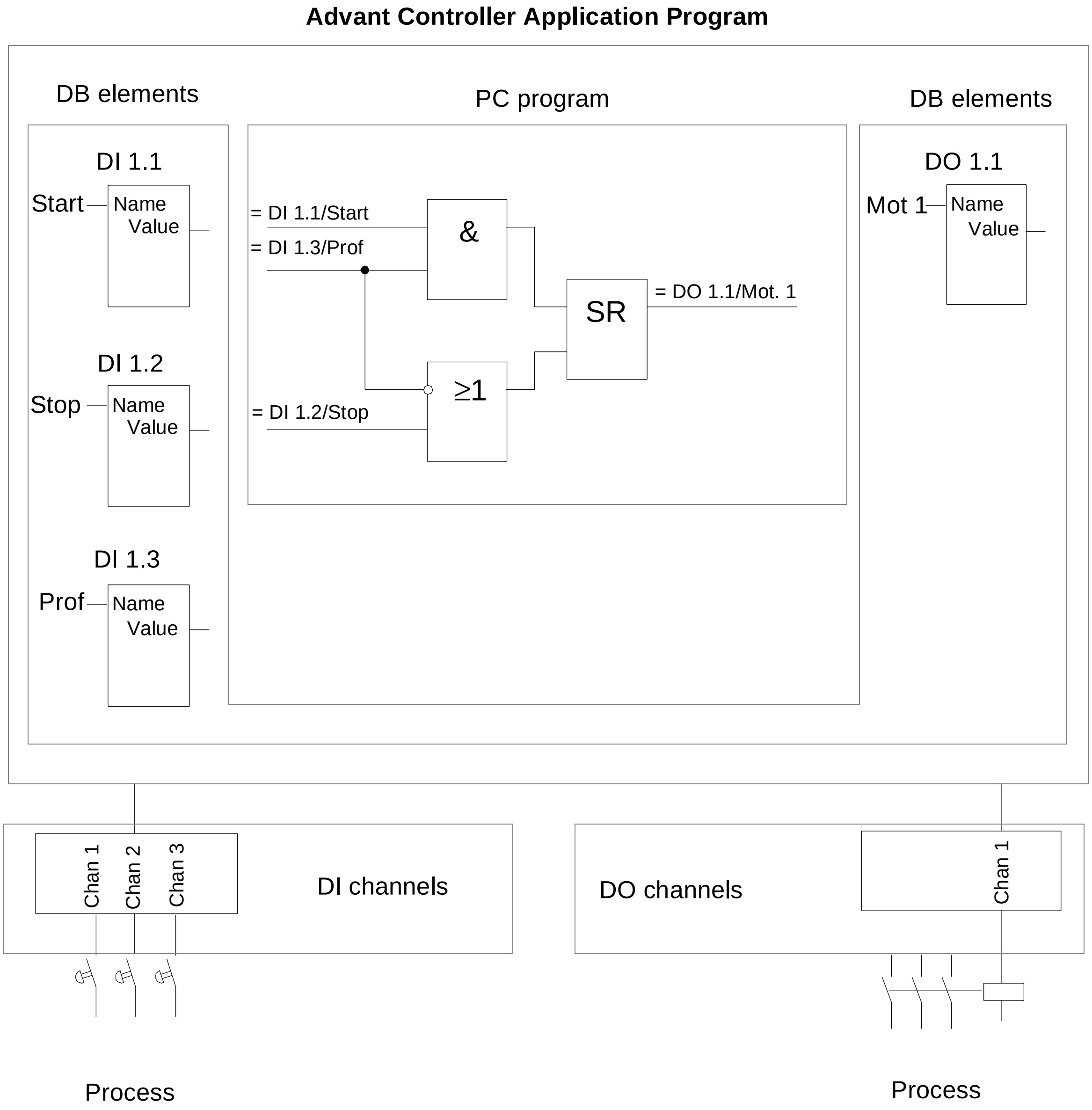


*Figure 3-4. Example of a Simple AMPL Program*

## 3.2.2 System Software

The Advant Controller 55 basic unit contains the PC element library as part of its system software (BASE library).

Additionally, a software option (OPT1) containing extended PC elements is available.
RCOM (OPT2) and event handling (OPT3) are built-in in the BASE system software and does not need to be loaded separately.

### 3.2.2.1 BASE

*Table 3-1. PC Elements of the System Software*

| Type | Function | PC Element |
|---|---|---|
| Structure | Structuring the PC program and sequential control | PCPGM, CONTRM, FUNCM, MASTER, SLAVEM, BLOCK, SEQ, STEP |
| Logic | Combinational logic and Boolean memory | AND, OR, AND-O, OR-A, XOR, INV, TRESH-L, SR, SR-AA, SR-AO, SR-OA, SR-OO, SR-D |
| Time | Timer for on- and off-delays, pulse functions, oscillator and calendar timing | MONO, TON, TOFF, TONRET, TRIGG, AND-TRG, OR-TRG, OSC-B, TIMER, SYSTIME |
| Register | Shift and queue register | FIFO, MOVE, REG, SHIFT |
| Switches | Switching sets of data | SW, SW-C |
| Multiplexer | Select data from a group of data | MUX-I, MUX-MI, MUX-MN |
| Code converters | Convert data from one type to another, e.g., Boolean to integer | CONV, CONV-BI, CONV-IB, BGET, BSET |
| Counter | Pulse counting | COUNT |
| Arithmetic | Basic arithmetic operations and square root, absolute value and limit functions | ADD, SUB, MUL, DIV, ABS, SQRT, ADD-MR, DIV-MR, MULDIV, LIM-N |
| Comparators | Comparison of two numbers, limit value monitoring and maximum or minimum selection | COMP-I, COMP-R, COMP-B, MAX, MIN |
| Supervision | Evaluate the load of an Advant Controller 55 system | SYSL |

### 3.2.2.2 OPT1

The option OPT1 adds the following PC elements to the BASE system software

*Table 3-2. PC Elements of the Option OPT1*

| Type | Function | PC Element |
|---|---|---|
| Function generator | Generates an output from an input variable according to a function described by a data table. | FUNG-1V |
| Filter | Single-pole low-pass filter. | FILT-1P |
| Feedback control | Various conventional P, I, and D functions and combinations thereof, a pulsed regulator and a ramp generator. | P-1, INT, DER, PI, PIP, PDP, CON-PU1, RAMP |
| Register | Register for assembling single data with a group data. | REG-G |

### 3.2.2.3 OPT2

The following RCOM DB elements (OPT2) are included in the BASE system software

*Table 3-3. DB Elements for RCOM (OPT2)*

| |
|---|
| MVICHAN |
| MVINODE |
| MVB |

### 3.2.2.4 OPT3

The following DB elements for event handling (OPT3) are included in the BASE system software.

*Table 3-4. DB Elements for Event Handling (OPT3)*

| |
|---|
| EVS(S) |
| AIC |
| DIC |

## 3.3 Advant Controller 55 Expansion Unit

You can add up to four expansion units to an Advant Controller 55 basic unit. These are interconnected by means of expansion unit cables (see Figure 4-4).

The expansion unit can be mounted side by side with the basic unit, if the standard flat cable is used for connection. You can connect the expansion unit below the basic unit if you use the longer extra expansion unit cable.

The address of the expansion unit is set automatically with the cable connection. In this way, you can be sure the address of each expansion unit connected to the same basic unit is unique.

From a user's point of view, expansion units are straightforward. You access the I/O channels in an expansion unit in exactly the same way as the I/O channels in the basic unit.

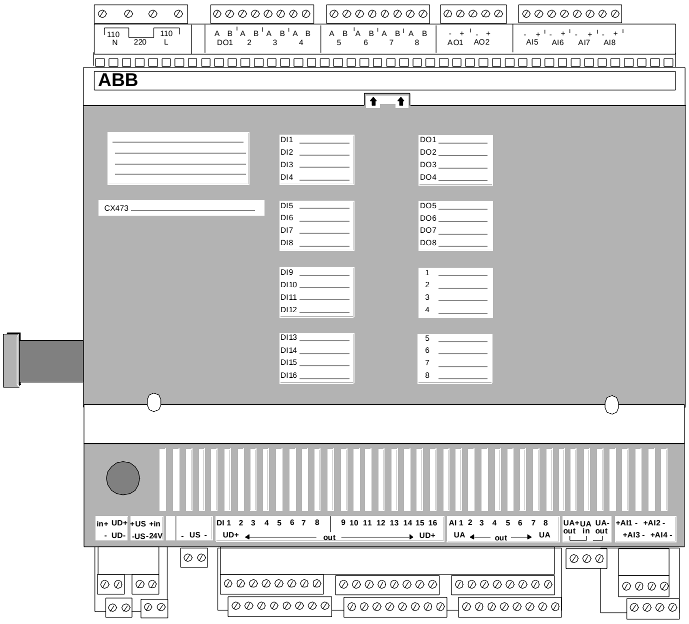


*Figure 3-5. Advant Controller 55 Expansion Unit*

## 3.4 Power Supply

The units can be supplied with an unstabilized 24 V DC voltage, 115 V AC or 230 V AC.

## 3.5 Advant Station 100 Series Engineering Station

Use the Advant Station 100 Series Engineering Station for program entry, testing, fault tracing and documentation of the Advant Controller 55 application program.

The following functions are provided:

- Off-line generation and downloading of complete application programs
- On-line modification of application programs
- Testing and fault tracing
- Tree editor for editing program structure
- PC diagram editor
- DB editor to configure DB elements
- Reading/setting of clock and calendar
- Generation and backtranslation of the AMPL source code
- Graphical documentation of application programs
- Display of detailed diagnostic information.

The Advant Station 100 Series Engineering Station is connected to the Advant Controller 55 via the serial interface (connector Channel 1) on the basic unit.

## 3.6 Diagnostics and Supervision Functions

The system performs a variety of diagnostic and supervision functions to continuously monitor the correct operation of the whole system. Each of the modules has its own diagnostic functions. The basic unit monitors the system as a whole by collecting all the diagnostic information and checking the consistency of the hardware configuration and the application software.

The supervision functions are subdivided into the following groups:

- Problem detection
- Signalling the nature of the problem
- Automatic reaction to problems.

Each unit is equipped with a four-LED indicator for diagnostic purposes.

| | | |
|---|---|---|
| RUN: | | During normal operation, the green LED RUN is lit on all units. |
| F: | (Fault) | The red LED FAULT lights only if a problem occurs on the unit. |
| P: | (Power) | Power supply 115/230 VAC or 24 V DC is available. |
| TP: | (Transducer Power) | Internally or externally generated process voltages are available. |

A unit indicating FAULT should be replaced by maintenance staff and shipped to an ABB repair center.

The status of the units and the I/O signals is also indicated by the associated DB elements. Missing units are signalled by the function supervising the configuration on the associated DB elements. The status signals on the DB elements can be processed by the PC program in the same way as other signals. This feature enables you to include your own error handling routines in application programs, e.g., to interlock control loops if important signals are disturbed.

More detailed information about problems can be displayed using the Advant Station 100 Series Engineering Station.

Severe problems (for example, component errors) in the central processing unit stop the system. Digital outputs are set to the off state and analog outputs are set to 0 mA.

The diagnostic function displays an error code on a group of eight LEDs on the basic unit to facilitate fault tracing.

The CPU checks the consistency of the unit configuration specified by the DB elements and the actual configuration of the units. If the unit installed does not correspond to the type of unit specified by the unit DB element, then the unit is not switched to active. The error is indicated on the associated channel DB elements and via an Advant Station 100 Series Engineering Station.

Units not having an associated unit DB element are not switched to active.

# Chapter 4 Hardware Description

## 4.1 System Hardware

Advant Controller 55 is designed for an industrial environment. It is equipped for direct connection to the process, to the mains and to the communication line via modem.

The enclosure is in accordance with IEC 529, IP 20. The Advant Controller 55 is designed to be mounted on a wall, but it can also be fitted in a cabinet or a box. The design is not confined to any particular cabinet and the minimum size is determined by the number of cables and marshalling.

There are two types of Advant Controller 55 units, the basic unit and the expansion unit.

### 4.1.1 Basic Unit

The case of the basic unit is a cast chassis of aluminum. The circuit boards are screwed into the cast chassis, which is used for heat dissipation and EMC (electromagnetic compatibility) reasons. You can mount the unit on the wall on a mounting panel or on two parallel DIN rails, see Chapter 5, Hardware Planning and Installation.

The chassis and the electronics are covered by a plastic cover. The plastic cover's function is to protect and to support other components. It should be removed by authorized personnel only.

On the front of the cover, a lid is mounted which covers the switches for mode select and the connector to the expansion unit. On the unit's type label, you can see the address of the unit (node number) when the lid is removed.

The basic unit contains 16 digital input channels and eight digital output channels. The signal status of each channel is indicated by a LED on the front of the unit. When the signal is set to '1,' the corresponding LED is set. Next to the LEDs, there are slots for labels which show the signal names indicated by the LEDs.

In addition to the channel indicators, eight LEDs are provided for system status indication and halt error codes. Three green LEDs and one red LED are provided for hardware status indication.

The process signals of the 16 digital inputs, eight digital outputs, eight analog inputs and two analog outputs, plus the connection to the power supply, are connected to one row of screw terminal blocks at the top of the unit and to two rows of screw terminal blocks at the bottom of the unit.

Two 9-pole sub-D bus connectors for connection to the AS 100 ES engineering station and to a modem for the RCOM (Remote COMmunication) line are located on the front side of the basic unit.

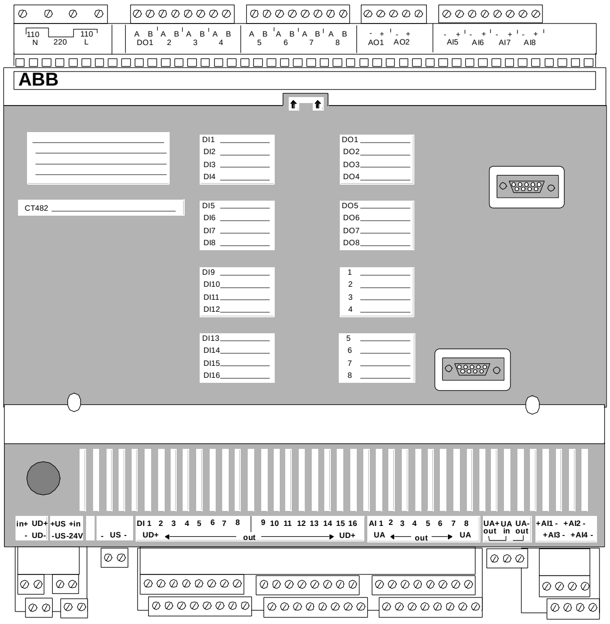


*Figure 4-1. Basic Unit*

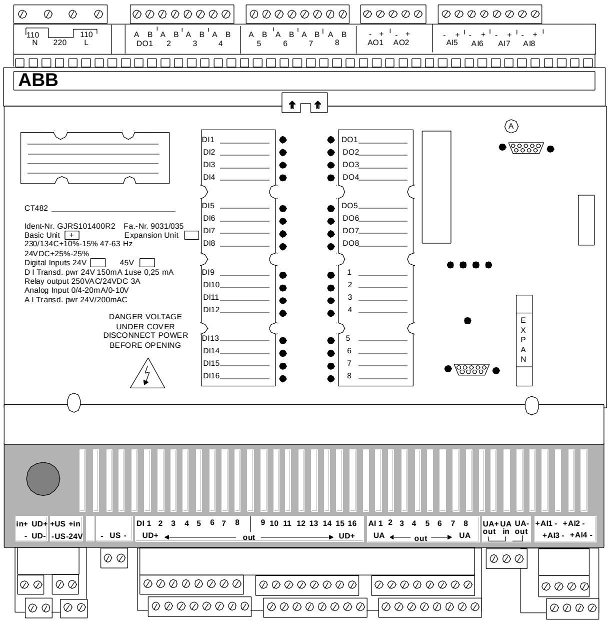


*Figure 4-2. Basic Unit with Lid Removed*

## 4.1.2 Expansion Units

The basic unit can be expanded by up to four expansion units, type CX473 or CX475. You can mix the two types.

Each unit has 16 digital inputs, eight digital outputs, eight analog inputs and two analog outputs. Thus, a maximum of 80 digital inputs, 40 digital outputs, 40 analog inputs and 10 analog outputs is available in one station.

The expansion units are mechanically constructed in the same manner as the basic units.

Channel status of digital inputs and outputs is indicated on the front cover of the expansion units in the same manner as on the basic unit. The lower right-hand group of eight LEDs on the expansion units has no function.

The four status LEDs have the same functions as the corresponding LEDs on the basic unit.

The process and power supply connectors are exactly the same as on the basic unit.

The expansion units CX473 and CX475 are not equipped with a CPU and so are not equipped with communication connectors, a START MODE selector or an INIT push button.

On the left-hand side of the expansion unit, there is a flat cable connector for the bus connection to a basic unit or, alternatively, to another expansion unit.

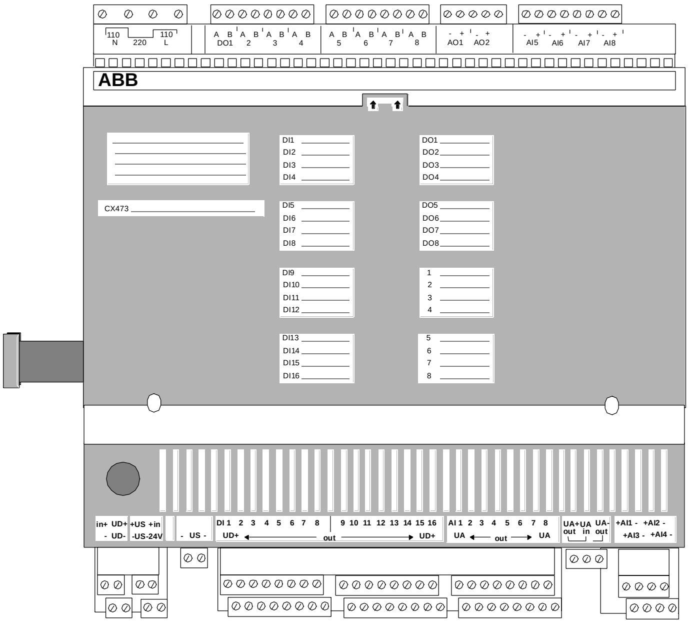


*Figure 4-3. Expansion Unit*

### 4.1.3 Dimensions

The basic unit and the expansion unit have the same dimensions.

The units are designed for installation side by side. They have a width of 240 mm, so two units mounted side by side conform to the 19-inch standard. Given their height, 240 mm, and their depth, 90 mm, you can install them in a wide variety of cabinets or boxes with varying dimensions. If the units cannot be mounted side by side, a longer extra expansion unit cable is provided. For installation details, see Chapter 5, Hardware Planning and Installation.

### 4.1.4 Expansion Unit Cable

The expansion unit cable makes the connection between connectors on the basic unit and the expansion unit(s). Do not use any cables other than the expansion unit cable because the connector pin allocation, the cable impedance and the cable length are precisely optimized for bus extension operation. See figure below.

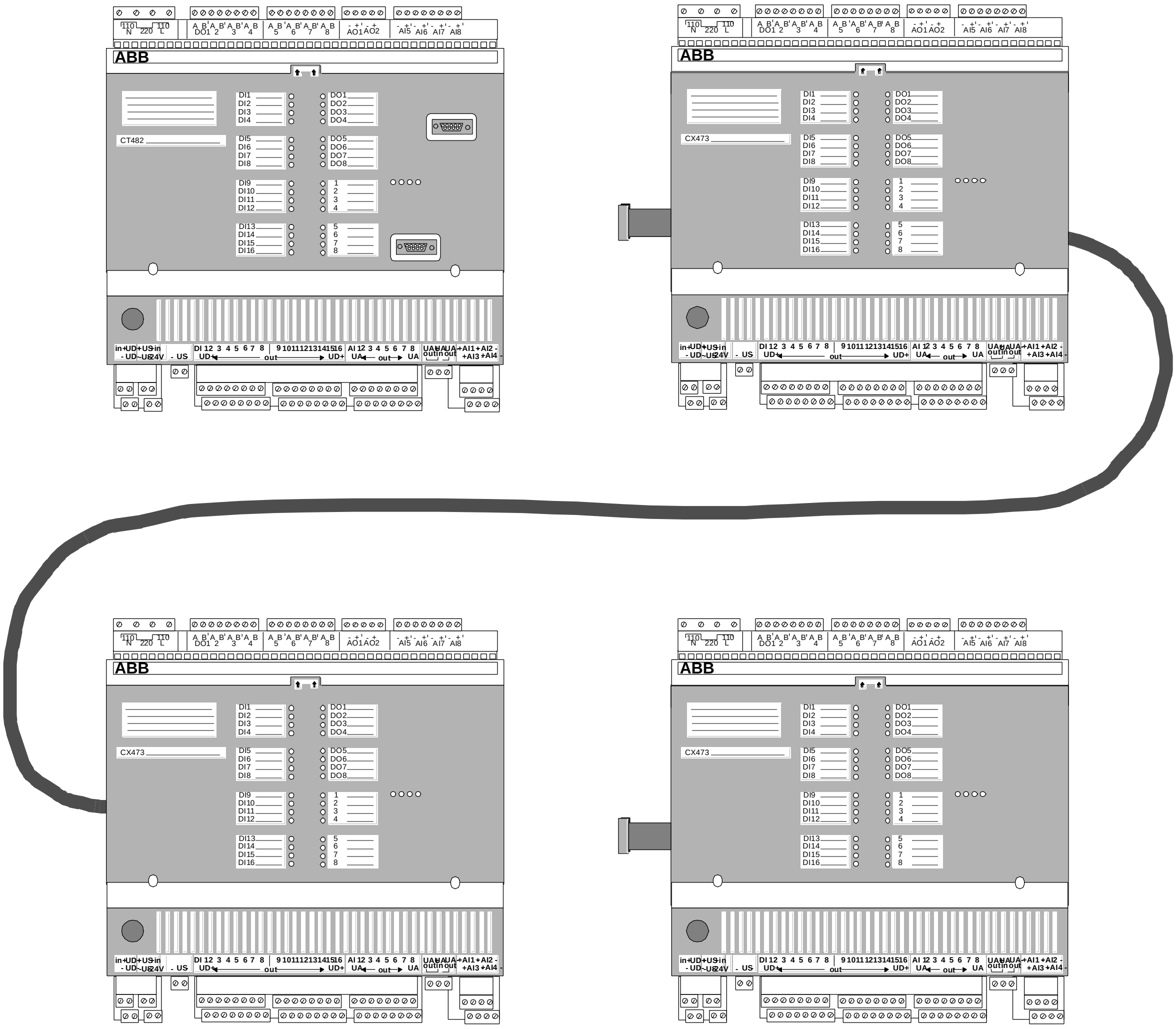


*Figure 4-4. Example with four Units mounted with Expansion Unit Cables*

## 4.1.5  Position Preferences, Restrictions

Altogether, the unit addresses are numbered 0 to 4. The unit address of the basic unit is always 0 and the unit addresses of the expansion units are 1 to 4. The unit addresses are automatically set in the order the units are connected.

Standard mounting of the basic unit is to the left of the first connected expansion unit.

### Basic Unit CT481, CT482

| | |
|---|---|
| Type: | Basic unit |
| No. of positions: | 1 |
| Purpose: | CPU, communication interfaces, I/O and expansion unit interface |
| Dimensions: | 240 mm x 240 mm x 90 mm |
| Weight: | 2.8 kg |

### Expansion Unit CX473, CX475

| | |
|---|---|
| Type: | Expansion unit |
| No. of positions: | 2 to 5 |
| Purpose: | I/O and expansion unit cable connection |
| Dimensions: | 240 mm x 240 mm x 90 mm |
| Weight: | 2.5 kg |

## 4.1.6 Block Diagrams

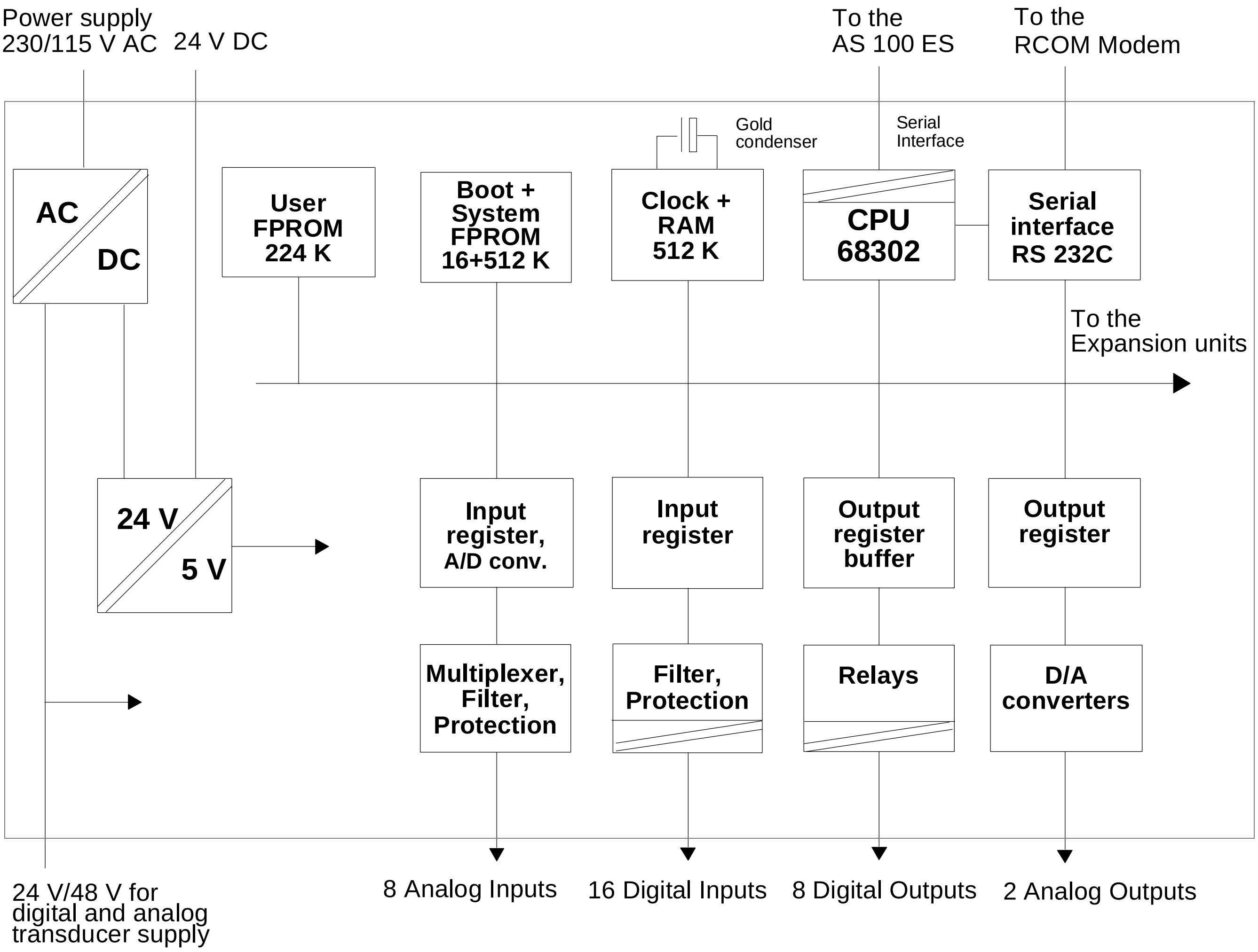


*Figure 4-5. Block Diagram Basic Unit*

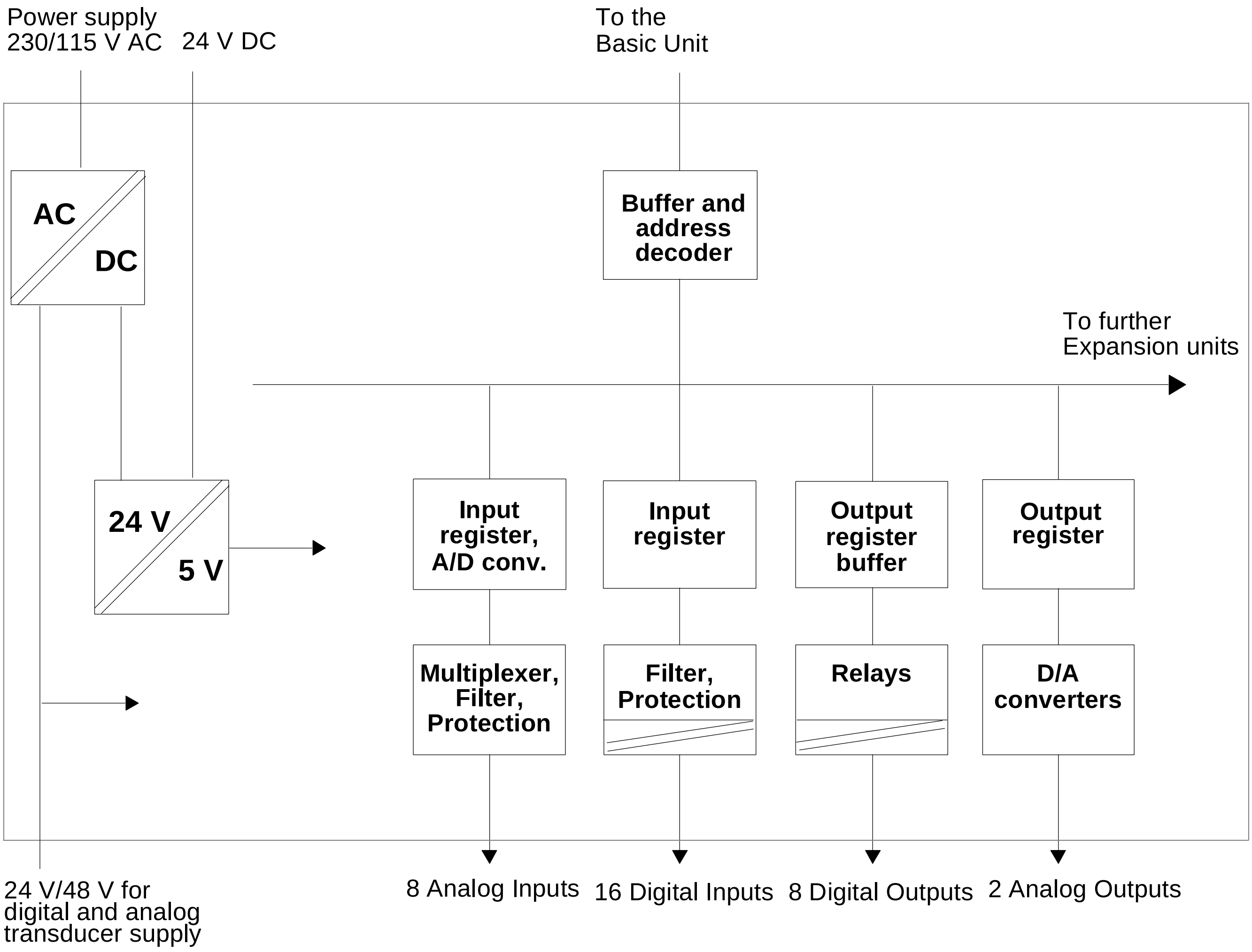


*Figure 4-6. Block Diagram Expansion Unit*

## 4.2 Power Supply

The basic unit and the expansion unit contain an integrated power supply.

The units may be supplied by 115 V AC, 230 V AC or 24 V DC.

The power supply includes excellent EMI filters and can buffer short primary voltage dropouts.

The power supply provides all internal voltages in addition to an analog transmitter supply. In case a 115 V AC or 230 V AC supply is used, a digital transducer supply is also built in.

All internal and external supply voltages are monitored and indicated by the hardware status LEDs. Error conditions are also indicated in the RCOM status word.

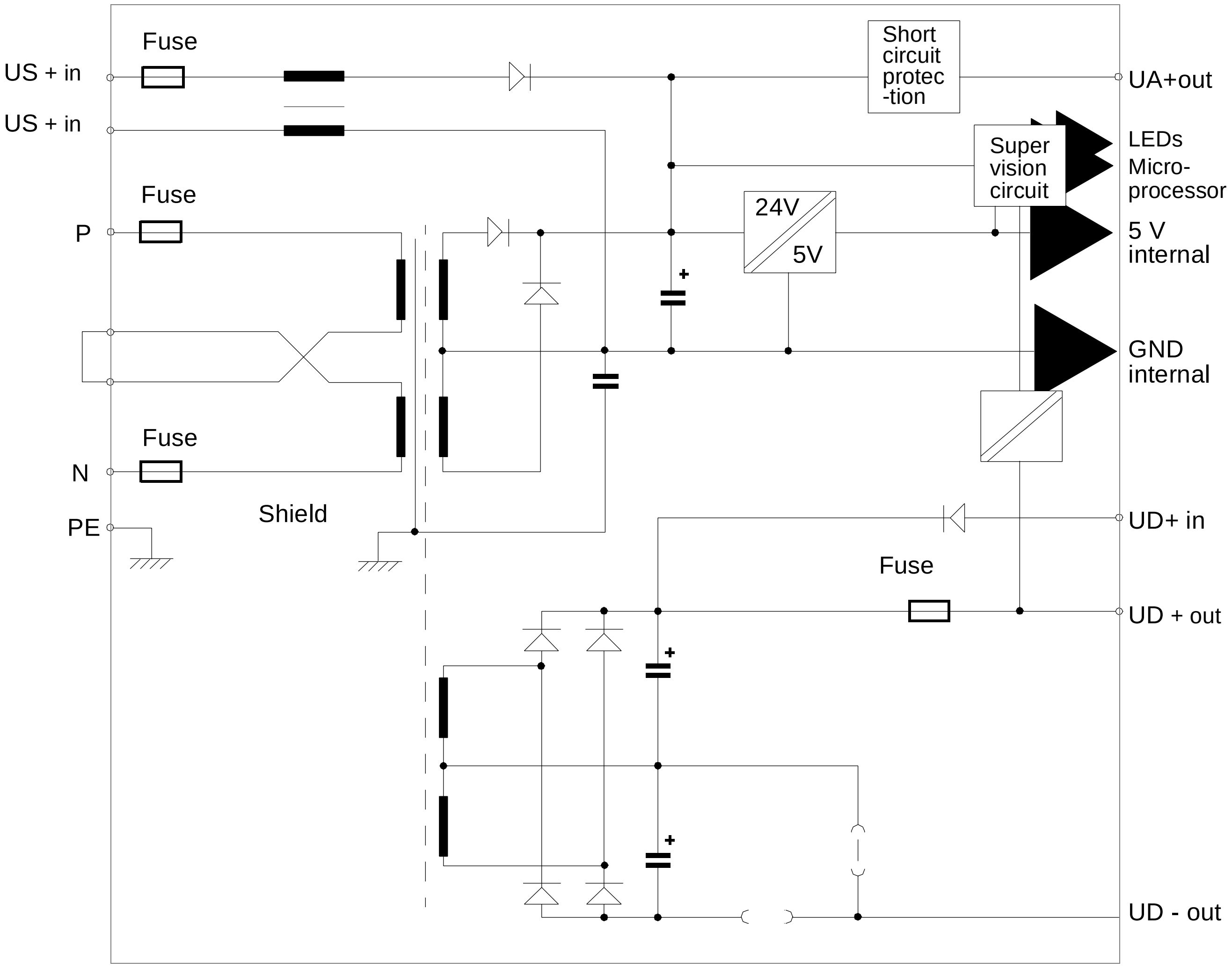


*Figure 4-7. Block Diagram of the Power Supply*

## 4.2.1 Principle of Operation

The power supply is a 115 V AC/230 V AC transformer with rectifier and filter for 24 V DC followed by a switched-mode DC/DC converter 24 V/5 V. As an alternative, you can connect it to a 24 V DC-line via the connector US + in, US - in, decoupled by an internal diode. The power supply for the basic unit and expansion units is identical and includes the following functions:

- 115 V AC/230 V AC transformer, rectifier and filter for 24 V DC internal voltage.
- DC/DC converter 24 V/5 V internal.
- 24 V DC short-circuit-protected analog transmitter supply.
- Separate potential isolated 24 V DC/48 V DC for digital transducer supply with fuse.
- Voltage supervision of internal 5 V, analog transmitter, digital transducer supplies.
- All line inputs protected by fuses.
- EMI filtering and shielding.

## 4.2.2 Supervision

The internal supervision circuit detects and signals failures in the power supply. Signalling is performed by the hardware status LEDs.

- Normal operation (5 V ok): Green LED (PW) lights.
- Analog transmitter supply overload: Green LED (TP) does not light.
- Digital transducer supply overload or missing: Green LED (TP) does not light.

### 4.2.3 Technical Data

*Table 4-1. Power Supply Technical Data*

| Power Supply | CT481, CT482 | CX473, CX475 |
|---|---|---|
| **Input for 230 V AC or 115 V AC** | | |
| Supply voltage | 230 V AC or 115 V AC | 230 V AC or 115 V AC |
| Tolerance | - 15 %... + 10 % from rated voltage | - 15 %... + 10 % from rated voltage |
| Frequency | 47...63 Hz | 47...63 Hz |
| Input current | 55 mA without<br>100 mA with transducer power supply. | 25 mA without<br>60 mA with transducer power supply. |
| Fusing internal | 160 mA T 2 Fuses | 160 mA T 2 Fuses |
| Potential isolation | By transformer | By transformer |
| Isolation voltage | 250 V AC | 250 V AC |
| Test voltage | 2500 V DC | 2500 V DC |
| | | |
| **Input for 24 DC** | | |
| Supply voltage | 24 V DC | 24 V DC |
| Tolerance | -25 %... + 25 % | -25 %... + 25 % |
| Max. overvoltage during 1 ms | 45 V | 45 V |
| Input current | 450 mA without<br>840 mA with transducer power supply | 200 mA without<br>600 mA with transducer power supply. |
| Fusing | 1 A T 1 Fuse internal | 1 A T 1 Fuse internal |
| Potential isolation | No | No |
| | | |
| **Power dissipation (unit)** | 13 W | 6 W |
| | | |
| **Digital transducer supply** | | |
| Voltage | 24 V DC CT481, 48 V DC CT482 | 24 V DC CX473, 48 V DC CX475 |
| Tolerance | -25 %... +25 % | -25 %... +25 % |
| Load current | < 200 mA | < 200 mA |
| Short-circuit protection: | By fuse 0,25 A, T | By fuse 0,25 A, T |
| | | |
| **Analog transmitter supply** | | |
| Voltage | 24 V DC<br>US in - 3 V in case of 24 V DC supply | 24 V DC<br>US in - 3 V in case of 24 V DC supply |
| Tolerance | -25 %... +25 % | -25 %... +25 % |
| Load current | < 200 mA | < 200 mA |
| Short-circuit protection: | Electronic | Electronic |

## 4.2.4 Examples of Connection

The following figures illustrate two examples of possible configurations:

- 24 V DC line
- 115 V AC or 230 V AC line.

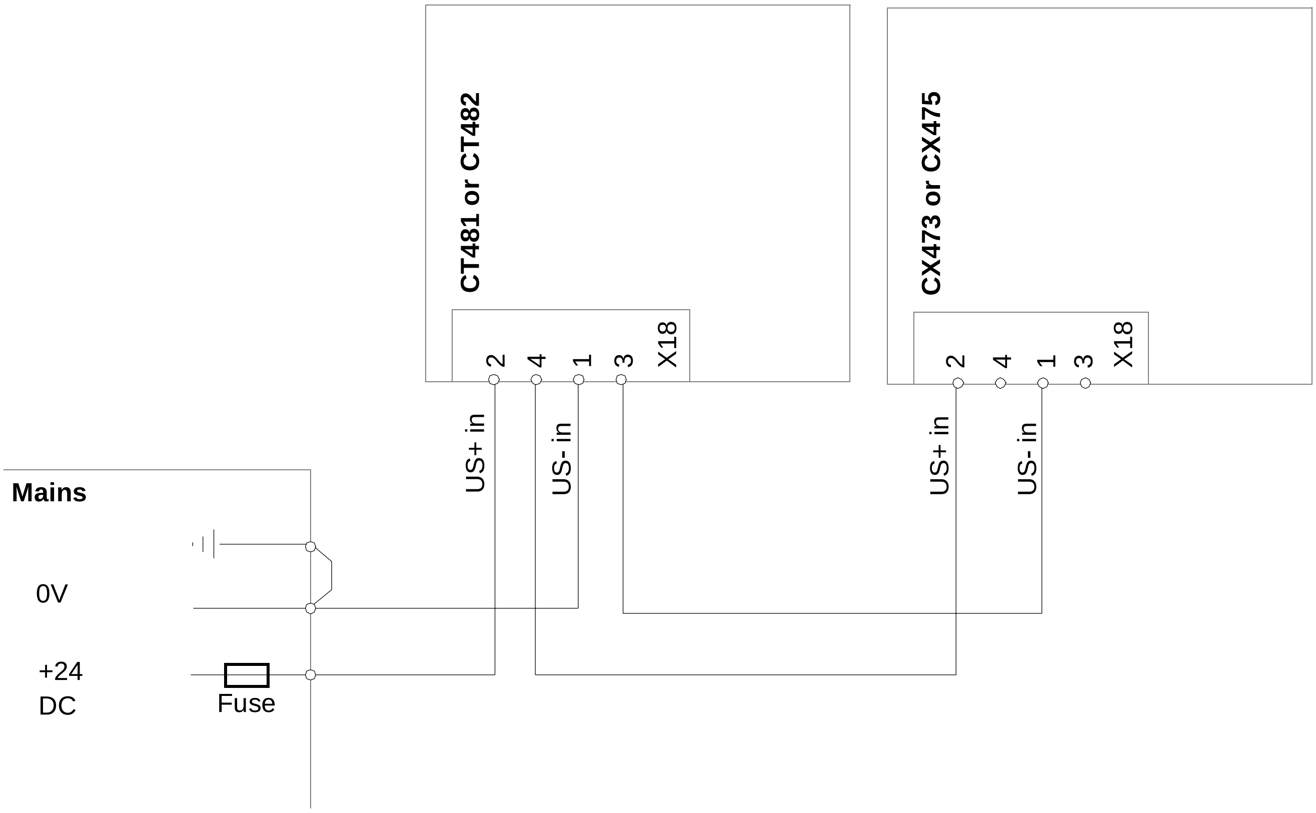


*Figure 4-8. Example of Connection with a 24 V DC Line.*
*Basic and Expansion Unit*

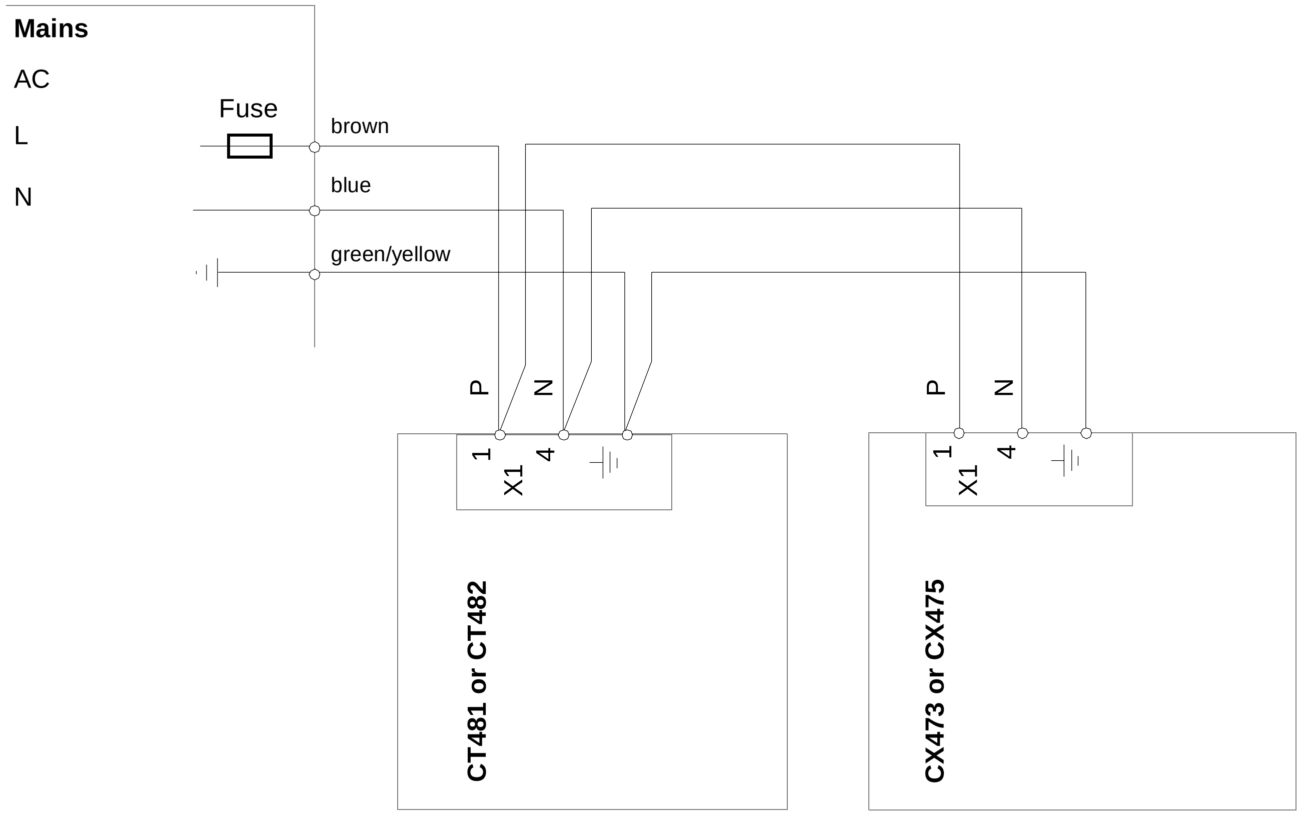


*Figure 4-9. Example of Connection with a 115 V AC or 230 V AC Line.*
*Basic and Expansion Unit*

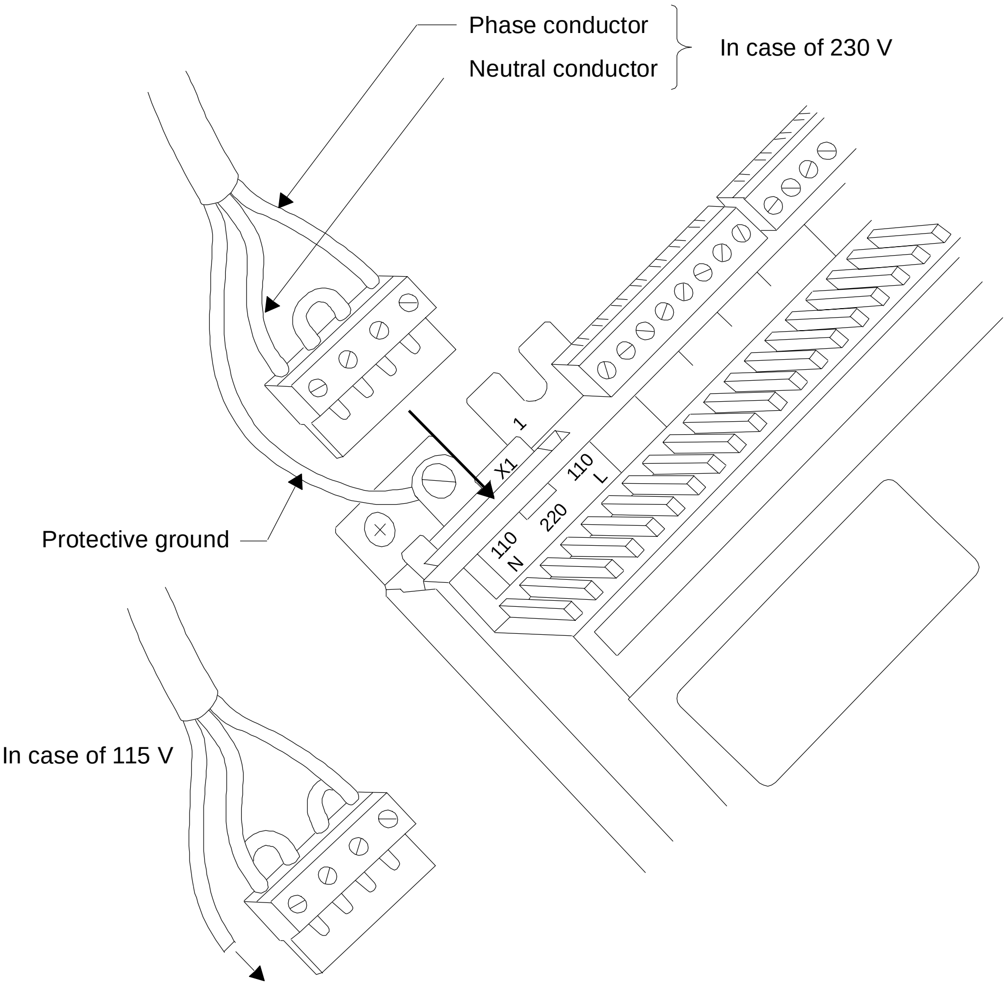


*Figure 4-10. Connection of Power Cable with a 115 V AC or 230 V AC Power Line*

## 4.3 Central Processing Unit

### 4.3.1 Functional Description and Supervision

The CPU is integrated in the basic unit.

The CPU module is based on a 16-bit Motorola 68HC302 processor. The system software includes diagnostic routines which check the CPU and the system during initialization and ensure system integrity during the execution of the application program.

During power-up, the functions of the processor and the contents of the application and system Flash PROM are checked, as well as the internal RAM of the CPU. While the application program is running, the diagnostic routines continue checking operation without delaying or influencing the execution.

The whole system is also supervised. Failures on I/O channels or units are detected and signalled. Additionally, a dedicated reaction can be defined by the application program.

The system software monitors whether the processor has sufficient capacity to perform its functions within the times specified. If it does not, the processor inhibits the application.

After an error occurs, the system software attempts to restart the CPU and to continue normal operation whenever possible.

The system software detects when the basic unit or expansion units are withdrawn.

**WARNING**

**Never connect or disconnect a unit under voltage because it may cause damage. Switch off the supply voltage, then connect or disconnect the unit.**

A unit which has been connected under voltage is not recognized by the CPU. It is only recognized if the supply voltage is switched on.

## 4.3.2 View

All of the following elements are located on the front of the basic unit:

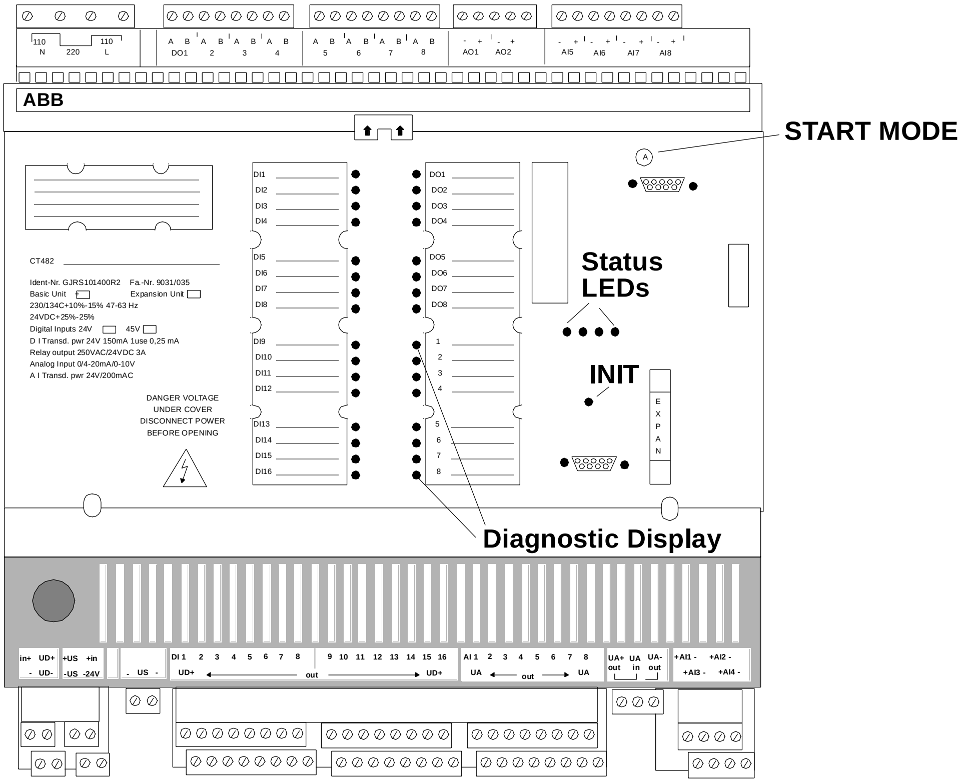

110 N 220 110 L
A B A B A B A B DO1 2 3 4
A B A B A B A B 5 6 7 8
- + - + AO1 AO2
- + - + - + - + AI5 AI6 AI7 AI8
ABB
START MODE
A
CT482
Ident-Nr. GJRS101400R2 Fa.-Nr. 9031/035
Basic Unit Expansion Unit
230/134C+10%-15% 47-63 Hz
24VDC+25%-25%
Digital Inputs 24V 45V
D I Transd. pwr 24V 150mA 1use 0,25 mA
Relay output 250VAC/24VDC 3A
Analog Input 0/4-20mA/0-10V
A I Transd. pwr 24V/200mAC
DANGER VOLTAGE
UNDER COVER
DISCONNECT POWER
BEFORE OPENING
DI1 DI2 DI3 DI4 DI5 DI6 DI7 DI8 DI9 DI10 DI11 DI12 DI13 DI14 DI15 DI16
DO1 DO2 DO3 DO4 DO5 DO6 DO7 DO8
1 2 3 4 5 6 7 8
Status LEDs
INIT
E X P A N
Diagnostic Display
in+ UD+ - UD-
+US +in -US -24V
- US -
DI 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
UD+ out UD+
AI 1 2 3 4 5 6 7 8
UA out UA
UA+ out UA in UA- out
+AI1 - +AI2 - +AI3 - +AI4 -

*Figure 4-11. Basic Unit with Lid Removed and View of the Diagnostic LEDs and Switches*

### Status LEDs

The colors of the four LEDs—RUN, F(FAULT), PW and TP—are defined as follows.

- Green: normal operation.
- Red: danger or fault.

| | |
|---|---|
| LED RUN lights: | The unit is working normally, with or without application. Input and output communication with the unit is active. |
| LED FAULT lights: | Severe faults are detected by the internal CPU checks. |
| LED PW lights: | Power supply (internal logic voltage) is ok. |
| LED TP lights: | Process voltage for digital or analog inputs is ok (digital transducer voltage, analog transmitter voltage). |

### INIT Push Button and START MODE Selector

The INIT push button and the START MODE selector are accessible if the lid is removed.

INIT:

Pressing the INIT push button initiates a CPU cold start.

START MODE:

The START MODE selector has three positions which influence the power-up and restart behavior of the CPU. If possible, a restart is made automatically after an error is detected. You will need a small screwdriver to operate the START MODE selector.

CLEAR - cold start (Position 2)

The initialization procedure starts from the beginning, and hardware and software are reset to their initial states. Application software is loaded from the internal PROM into the RAM. The cold start procedure is executed after you power-up and press the INIT push button.

AUTO - warm start (Position 3)

The system software attempts to restart the application program after an error occurs, and in doing so, checks the integrity of the application program loaded. If a restart is possible, the system software continues executing the application program. If the application program is corrupted, a cold start is executed.

STOP (Position 1)

You can prevent the application program from starting if the start mode selector is in the stop position. The system software continues execution to allow access to the stored error messages using the Advant Station 100ES.

Do not use the other positions (0, 4 - 9 and A - F). They are redundant.

### Diagnostic Display

The diagnostic display is the group of eight LEDs located in the lower right-hand portion of a basic unit. It indicates:

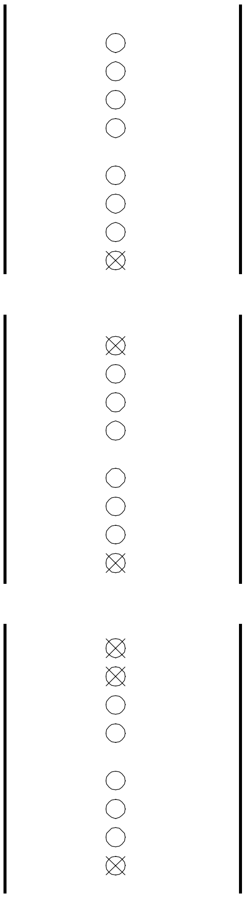
- Error codes in case of a system stop

  The LED RUN does not light and the lowest LED does not light on the diagnostic display.

- CPU functions in the system

  The lowest LED is always lighted in the LED field. The other LEDs indicate the control mode in accordance with the examples below.

The CPU control mode is indicated in the following way:

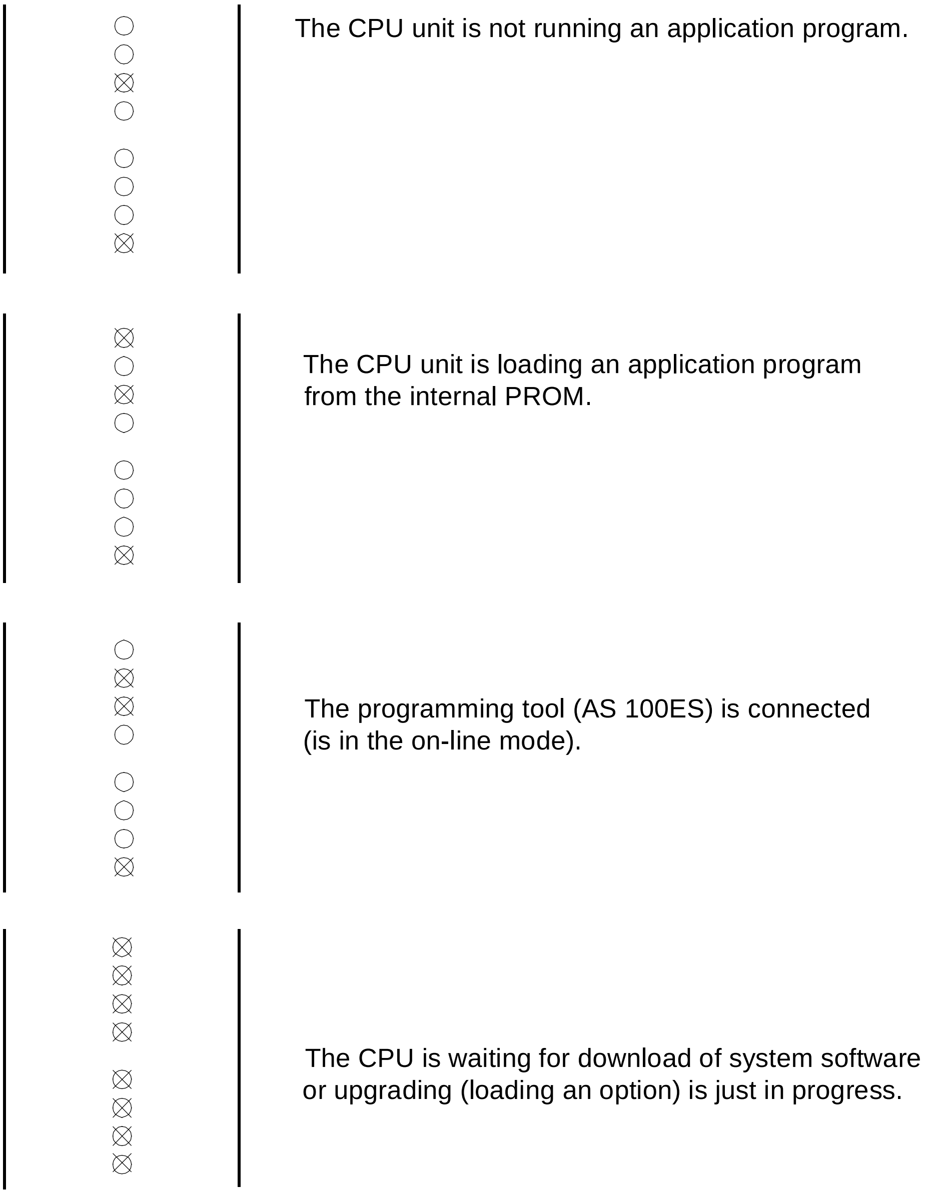


The CPU is in its initial phase.

The CPU unit is in its operational mode.

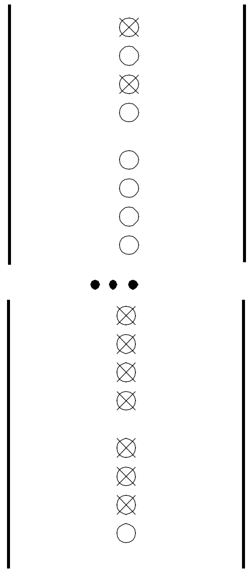
The CPU has stopped after initialization;
**START MODE** selector in position **STOP**.

*Figure 4-12. Example of Diagnostic Display*



| | |
|---|---|
| ○<br>○<br>⊗<br>○<br><br>○<br>○<br>○<br>⊗ | The CPU unit is not running an application program. |
| ⊗<br>○<br>⊗<br>○<br><br>○<br>○<br>○<br>⊗ | The CPU unit is loading an application program from the internal PROM. |
| ○<br>⊗<br>⊗<br>○<br><br>○<br>○<br>○<br>⊗ | The programming tool (AS 100ES) is connected (is in the on-line mode). |
| ⊗<br>⊗<br>⊗<br>⊗<br><br>⊗<br>⊗<br>⊗<br>⊗ | The CPU is waiting for download of system software or upgrading (loading an option) is just in progress. |

*Figure 4-13. Examples of Diagnostic Display (Continued from Figure 4-12)*



**HALT error codes, dual coded**
(The lowest LED is off)

See Table 7-1 in Chapter 7.

*Figure 4-14. Examples of Diagnostic Display (Halt Error Codes)*

### Serial Interface Connections

There are two serial interfaces on the CPU module:

- Front connector Channel1 to connect the AS 100ES programming tool. A cable is required for connection. Communication speed is fixed at 9600 bit/sec.
- Front connector Channel2 for exchanging data using the RCOM protocol. A standard cable is required for connection to a modem for the RCOM line. Communication speed is in the range of 300 to 19200 bit/sec.

### Memory Buffering

A gold condenser is used to back up the internal RAM of the CPU and the calendar chip, typically for one day.

## 4.3.3 Memory

The basic unit (CPU) is supplied complete with a built-in memory. No extra memory modules are required.

The application program is stored in a Flash PROM. The code of the application is basically held in 224 kilobytes. The application runs from a RAM copy of the Flash PROM.

On the CPU, 512 kilobytes of RAM is available. Roughly 300 kilobytes of the internal RAM is available for application purposes, i.e., the RAM copy of the Flash PROM and the data areas required by the program.

The RAM copy of the program permits easy and quick modification and debugging of an application. After you modify an application, you can copy the new version back to the Flash PROM (back up).

The BASE system software and the extensions (options) are loaded into the Flash PROM. It is not necessary to replace the PROM or open the basic unit to do this.

The necessary bootstrap loader is stored in an additional 16 kilobytes of Flash PROM, which is protected against being erased.

## 4.3.4 Technical Data

*Table 4-2. Basic Unit (CPU) Technical Data*

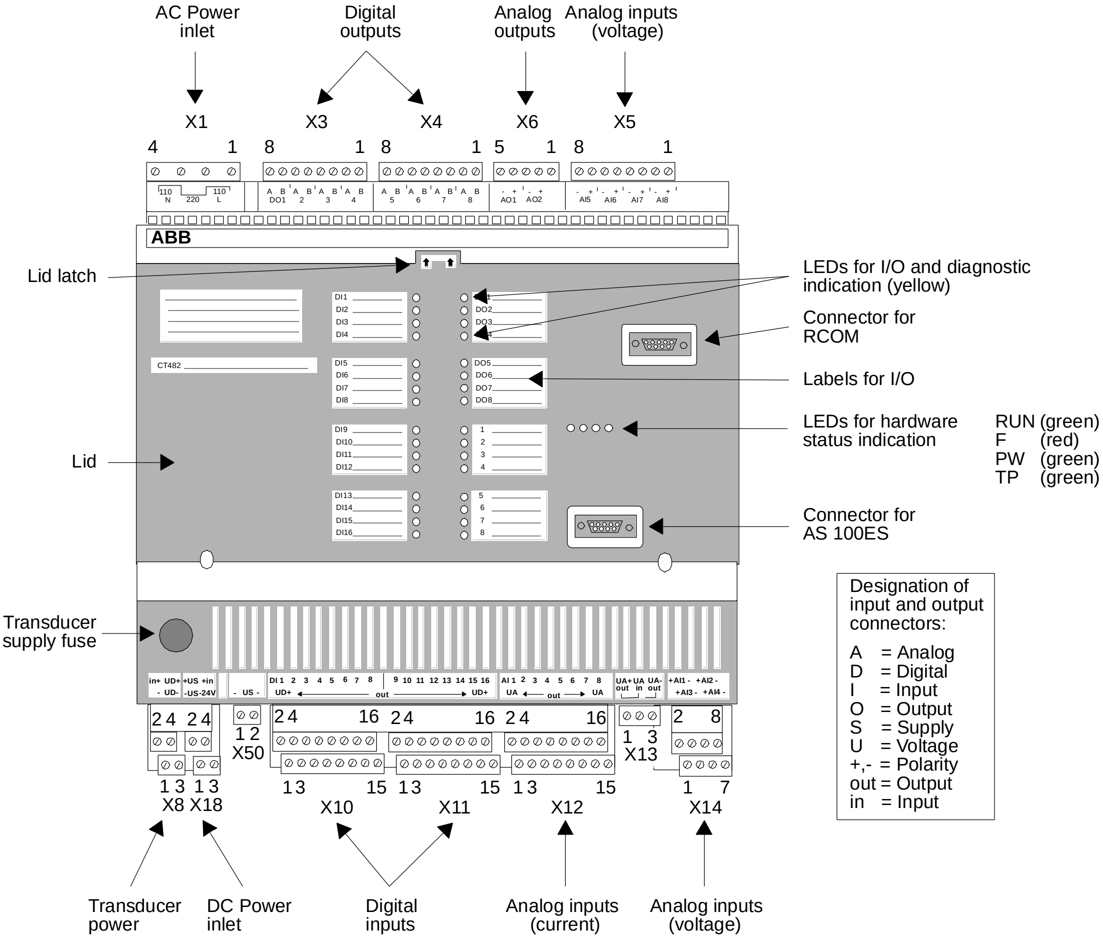
| **Basic Unit CPU Part** | **CT481, CT482** |
|---|---|
| Processor | Motorola 68HC302/ 16 MHz |
| Memory | 16 kbytes boot Flash PROM<br>512 kbytes Flash PROM for system software<br>224 kbytes Flash PROM for application programs<br>512 kbytes RAM for application and system purposes |
| Realtime clock | Built in for time and calendar functions |
| Interfaces | 1 RS 232C opto-isolated serial interface (Channel1)<br>1 RS 232C non-isolated serial interface (Channel2) |
| Interface connector for AS 100 ES | 9-pin Sub-D, female Channel1<br>Pin 2 - TxD<br>Pin 3 - RxD<br>Pin 5 - GND |
| Interface connector for RCOM Modems | 9-pin Sub-D, male Channel2<br>Pin 1- DCD<br>Pin 2- RxD<br>Pin 3- TxD<br>Pin 4- DTR<br>Pin 5- GND<br>Pin 6- DSR<br>Pin 7- RTS<br>Pin 8- CTS<br>Pin 9- RI |

# 4.4 Process Inputs and Outputs

## 4.4.1 Process Connectors

The Advant Controller 55 I/O channels are connected to the process by screw terminal connector blocks with two rows at the top of the units and one row at the bottom of the units. Up to 85 of the screw terminal contacts are used for process signals.The screw terminals can accommodate wire gauges from 0.5 mm$^2$ to 1.5 mm$^2$. The complete set of screw terminal connector blocks is delivered with the unit. The process connections are the same for the basic unit and for the expansion unit.

### 4.4.1.1 Process Connections to the Basic Unit

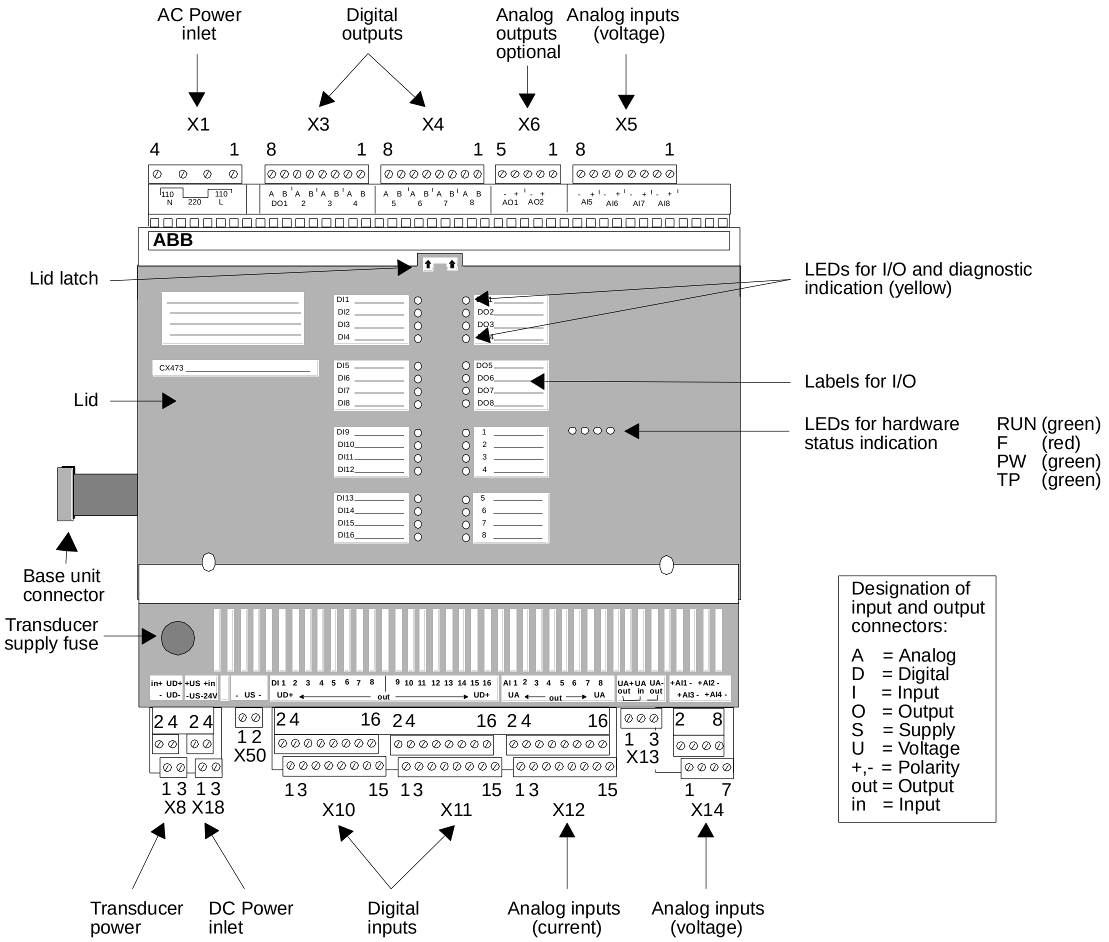


Designation of input and output connectors:

A = Analog
D = Digital
I = Input
O = Output
S = Supply
U = Voltage
+,- = Polarity
out = Output
in = Input

*Figure 4-15. Process Connectors with Screw Terminals for the Basic Unit*

### 4.4.1.2 Process Connections to the Expansion Unit



Designation of input and output connectors:

A = Analog
D = Digital
I = Input
O = Output
S = Supply
U = Voltage
+,- = Polarity
out = Output
in = Input

*Figure 4-16. Process Connector with Screw Terminal Blocks for the Expansion Unit*

## 4.4.2 Information and Indications on Front of Units

### Indication of Channel Status

On the front of the basic and expansion units, in the middle you will find 32 LED indicators. The first six groups of four LEDs are used to indicate the channel status: 16 DI LEDs and eight DO LEDs. The last two groups of four LEDs (eight LEDs) are used for error and status information. See Section 4.3, Central Processing Unit.

Digital inputs and outputs have a yellow LED for each channel to signal the status of the channel. The LED lights when the channel is "ON" (=1). The LEDs are located beside the fields with the channel numbers, making it easy for you to see the status of each channel.

### Tag Fields for the Units and the I/O Signals

You can find the following basic information on the front of the unit:

- Type designation at the left.
- Short Info (factory number, basic technical data of the I/O) (you can see this Short Info if the lid is removed).

In addition to this basic information, you can find the unit's node number and a further description on the paper containing the type designation. You can see the type designation and the noted information through the transparent windows in the lid covering the front.

There are two standard preprinted strips for each unit. The channel numbers are printed on the preprinted strips, level with the corresponding LEDs, making it easy to find the signal belonging to a particular channel. The names and descriptions of the signals also appear on the preprinted strips. You can see the preprinted channel numbers, the noted names and the descriptions through the transparent windows in the lid.

### Connection Diagram

There is a standard scheme for allocating available process connector terminals to process signals. The connection diagram shows these schematics, the process power supplies and the relationship between process channels and connector terminals (UP, ZP and channel/terminal number).

The diagram also shows any internal connections between pins and gives examples of how to connect sensors, actuators, etc. The terminal designations on the diagram have the same appearance as the process connector terminals, which simplifies wiring and tracing connections.

## 4.4.3 Analog Inputs

The two types of analog inputs convert analog input signals from transducers to digital values required by the programmable controller. There are inputs for current or for voltage signals. The type of input (current or voltage) can be selected individually for each channel at the DB element.

All modules are equipped with internal analog multiplexers. The A/D converter is part of the basic unit. The input signals pass through analog and digital filters.

The units have up to eight channels. The connections and functions of the analog inputs are the same for basic and expansion units. Interference suppression, signal filtering, offset and gain correction are performed either individually or together for all channels. Under program control, the multiplexer connects one input channel at a time to the A/D converter.

There are special DB elements for the I/Os. ERR output terminals of these DB elements, set to ‘0,’ indicate that the A/D conversion is operating normally.

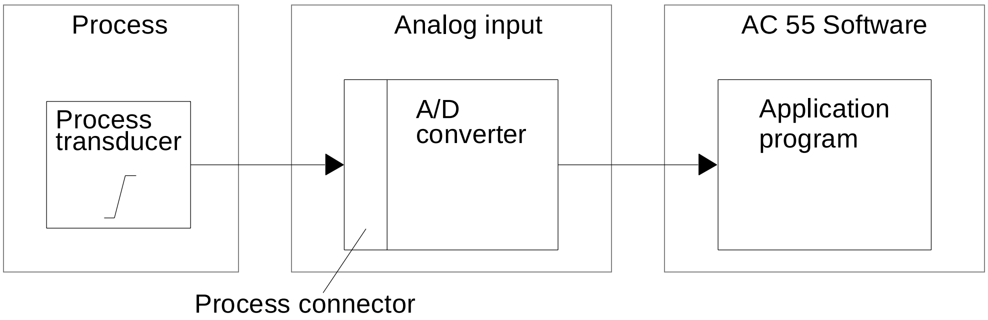


*Figure 4-17. Block Diagram of an Analog Input*

A green LED (TP) on the front of each unit indicates that the internal analog and the internal or external digital transducer power supplies are ok. If the analog transducer supply is cut short, the LED TP is not lit and a ‘process voltage error’ (PVOLTERR) is signalled at the corresponding unit’s DB element.

If a severe fault in the corresponding unit is detected, the LED (F(FAULT)) on the front of the unit lights and an ‘error’ (ERR) is signalled at the corresponding unit’s DB element.

### 4.4.3.1 Reading Analog Input Signals

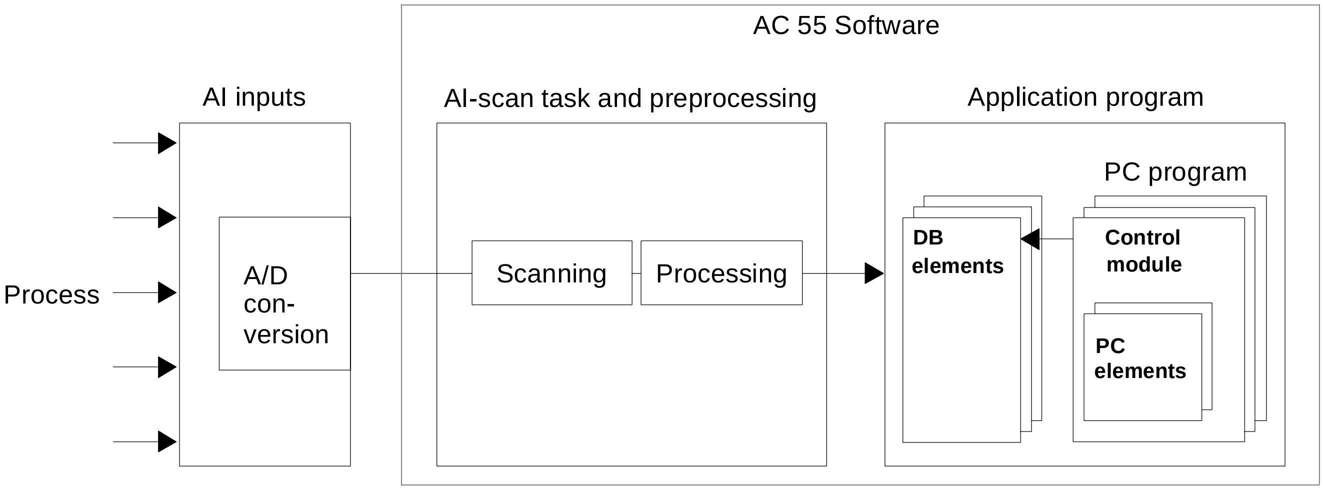


*Figure 4-18. Reading Process Values*

An application program consisting of PC and DB elements runs cyclically in the AC 55 programmable controller. Before the execution of a program module (e.g., control module), the CPU reads the input signals from a memory location. An AI scan task controls the A/D converter converting a signal, performing its processing (see below) and writing the signal into that memory location. The cycle time of the scan task is about 60 ms, determined by the interrupt of the A/D converter if it has finished conversion. The scan task processes one AI signal in every cycle. The AI signals used in the application are processed one after the other in successive AI scan task cycles.

### 4.4.3.2 Processing Current and Voltage Signals

The hardware and software signal processing of an AI signal involves the following procedures.

Filtering and A/D conversion:

- Prefiltering and gain control
- Conversion of analog signal to digital signal
- Digital filtering.

Signal range and supervision:

- Signal range
- Overrange and live zero supervision
- Limit check with hysteresis.

The following diagram shows how standard current and voltage signals are processed.

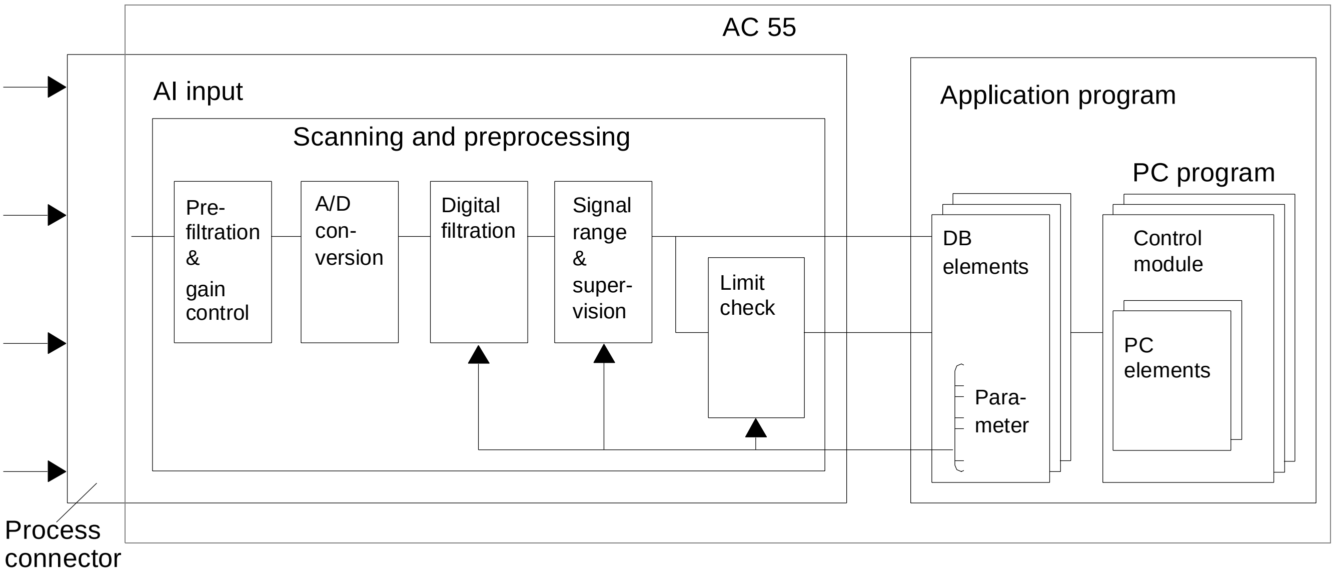


*Figure 4-19. Preprocessing AI signals*

### Filtering and A/D Conversion

The input signals pass through an analog lowpass filter to remove high-frequency interference.

Filtered signals are transferred by an analog multiplexer to an instrument amplifier and conditioned for the A/D conversion.

On the basic unit, the A/D converter is integration type. The input signal is integrated for one or more cycles of the mains frequency to ensure that all interference from mains is suppressed.

After A/D conversion, the signals are filtered a second time by a digital filter to suppress the mains frequency noise interference. Mains frequency of 50 Hz or 60 Hz can be selected at the basic unit DB element.

### Signal Range and Supervision

Excursions of the input signal outside its permissible range, i.e., input signals five percent greater than the normal input range, are indicated as errors in the data base elements.

The SW also checks the live zero signal in a measuring range of 4 - 20 mA.

The analog input value in the application program is always represented by a percentage, i.e., 100 corresponds to - 20 mA or - 10 V, depending on the selected range.

### Data Base Element Parameters

You can set a number of parameters of the data base elements for the AI inputs.

You can set the following parameters individually for each input channel:

- Channel active (on or off)
- Conversion parameter (signal range +/- 20 mA, 4 - 20 mA, +/- 10 V)
- Two low-limit values
- Two high-limit values
- One hysteresis.

Common for all input channels:

- Digital filtering (mains frequency 50 or 60 Hz).

You can determine whether or not the signal is designated active. If the signal is designated inactive, the value for the corresponding channel in the data base element is not updated.

The limit check can supervise four limits: two low limits and two high limits. The limits have a hysteresis which is always within the limit (see figure below). Limit values and hysteresis are determined by parameters in the data base elements. The unit of limits and hysteresis for measuring voltage or current values are specified in a percentage.

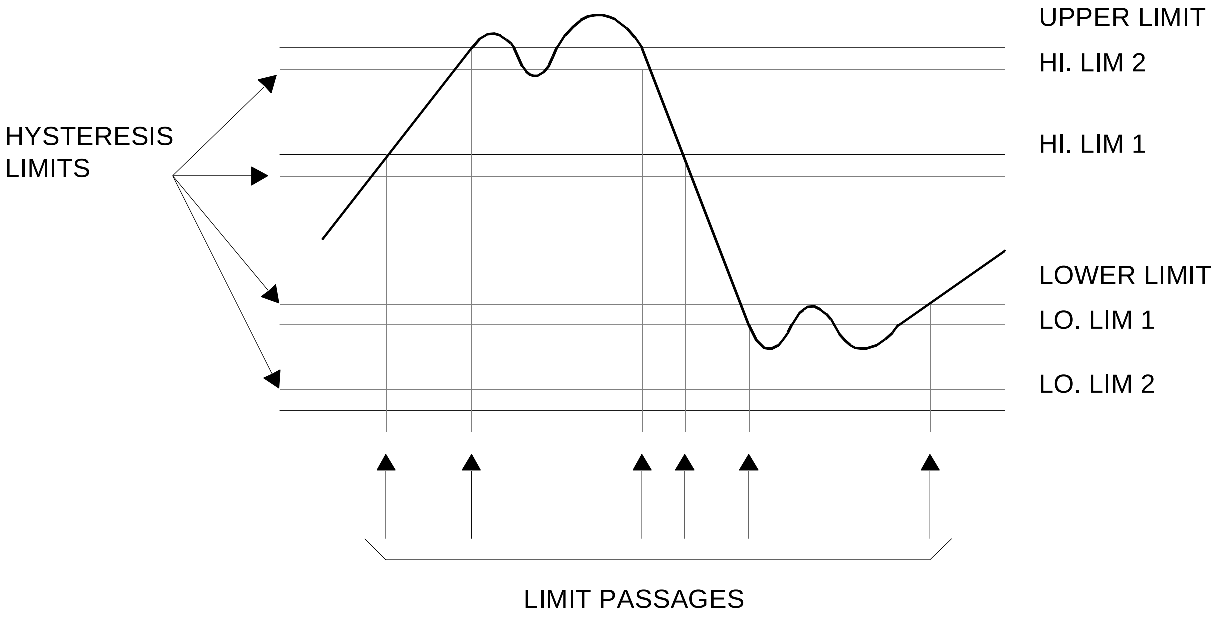


*Figure 4-20. Limit Check with Hysteresis*

The data base elements also contain information (signals) identifying limits which have been exceeded. This information (signals) is accessible for PC elements.

## 4.4.3.3 Technical Data

*Table 4-3. Technical Data on Analog Inputs*

| Analog Input | Current (all units) | Voltage (all units) |
|---|---|---|
| No. of inputs | 8 per unit | 8 per unit |
| Type of input | Single-ended | Differential |
| Measurement range | 4 - 20 mA<br>-20 - +20 mA | -10 - +10V |
| Overrange (1) | <3.8mA; >21 mA<br><-21 mA; >21 mA | <-10.5 V >10.5V |
| Live zero error | <2 mA | |
| Input resistance | 50 Ohms | 110 kOhms |
| Analog input error<br>Max error at 25°C<br>Temp. coefficient | <br>0.2 %<br>0.008 %/°C | <br>0.2 %<br>0.008 %/°C |
| Resolution | 11 bits + sign | 11 bits + sign |
| Common mode voltage CMRR | | 1 V (2) 60 dB |
| Series mode suppression Filter (50, 60 Hz) | 50 dB | 50 dB |
| Conversion | Integrating | Integrating |
| Conversion time<br>- per channel | <br>60 ms | <br>60 ms |
| Isolation | No | No |
| Absolute maximum value<br>current<br>voltage | <br>70 mA | <br><br>±33 V |

(1) Values are represented by “NAN” (Not A Number).
(2) Between channel AIx- and UA- out.

## 4.4.3.4 Process Connection

The following figures show the front view of the connectors for analog inputs and the connection diagram. The connection diagrams of the basic unit and the expansion unit are the same.

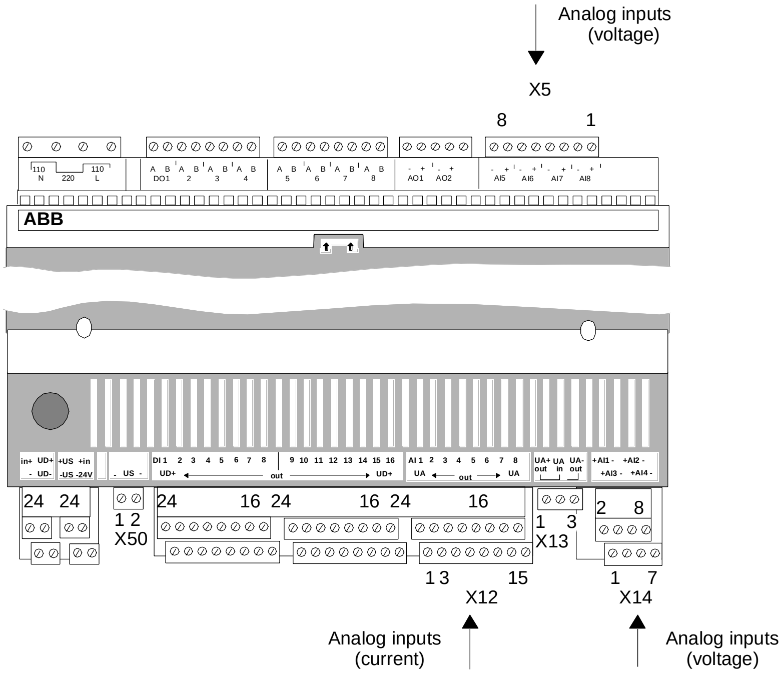


*Figure 4-21. View of the Connectors for Analog Inputs*

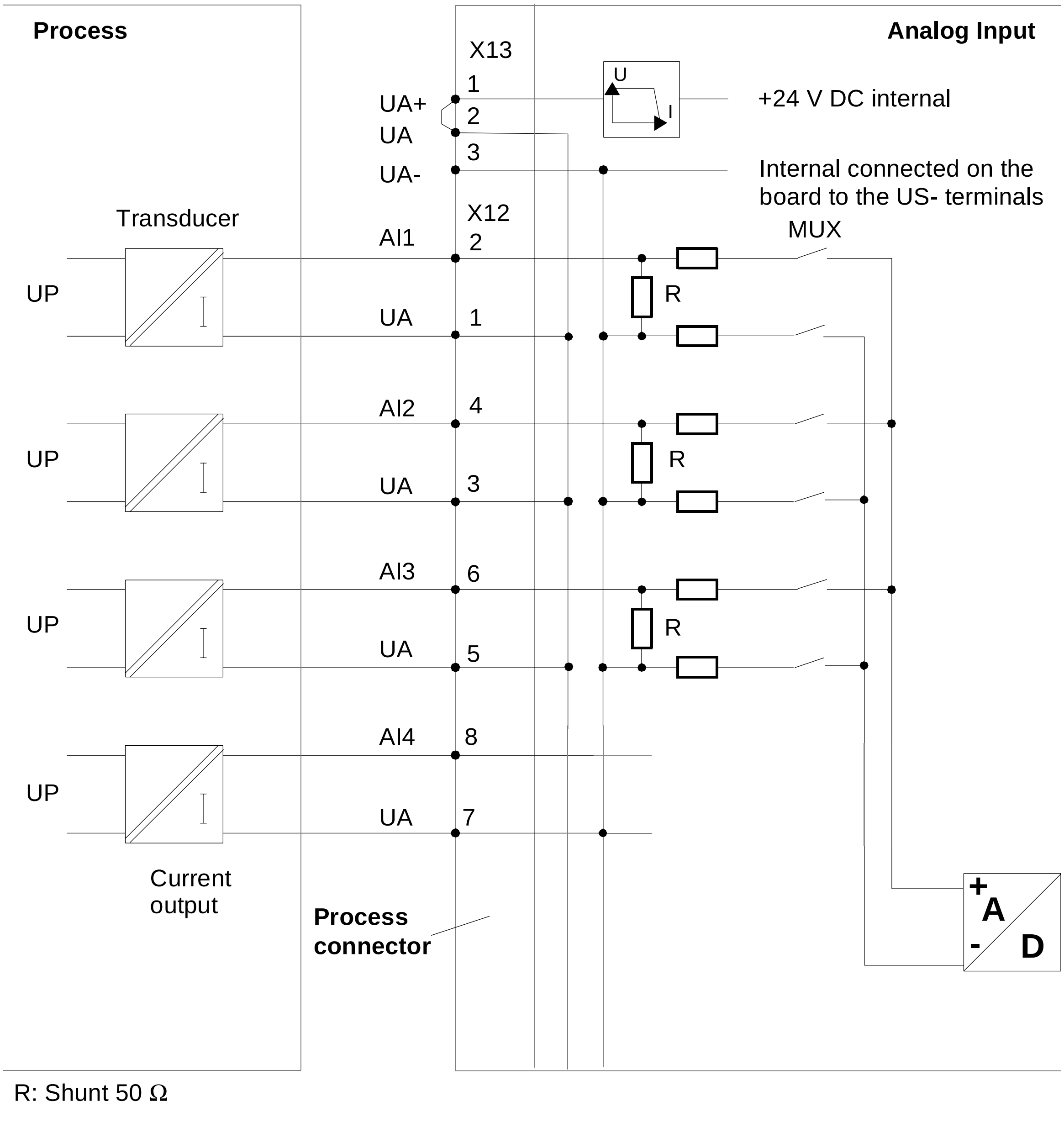


*Figure 4-22. Example of Connection of Analog Current Inputs for Passive Transducers*

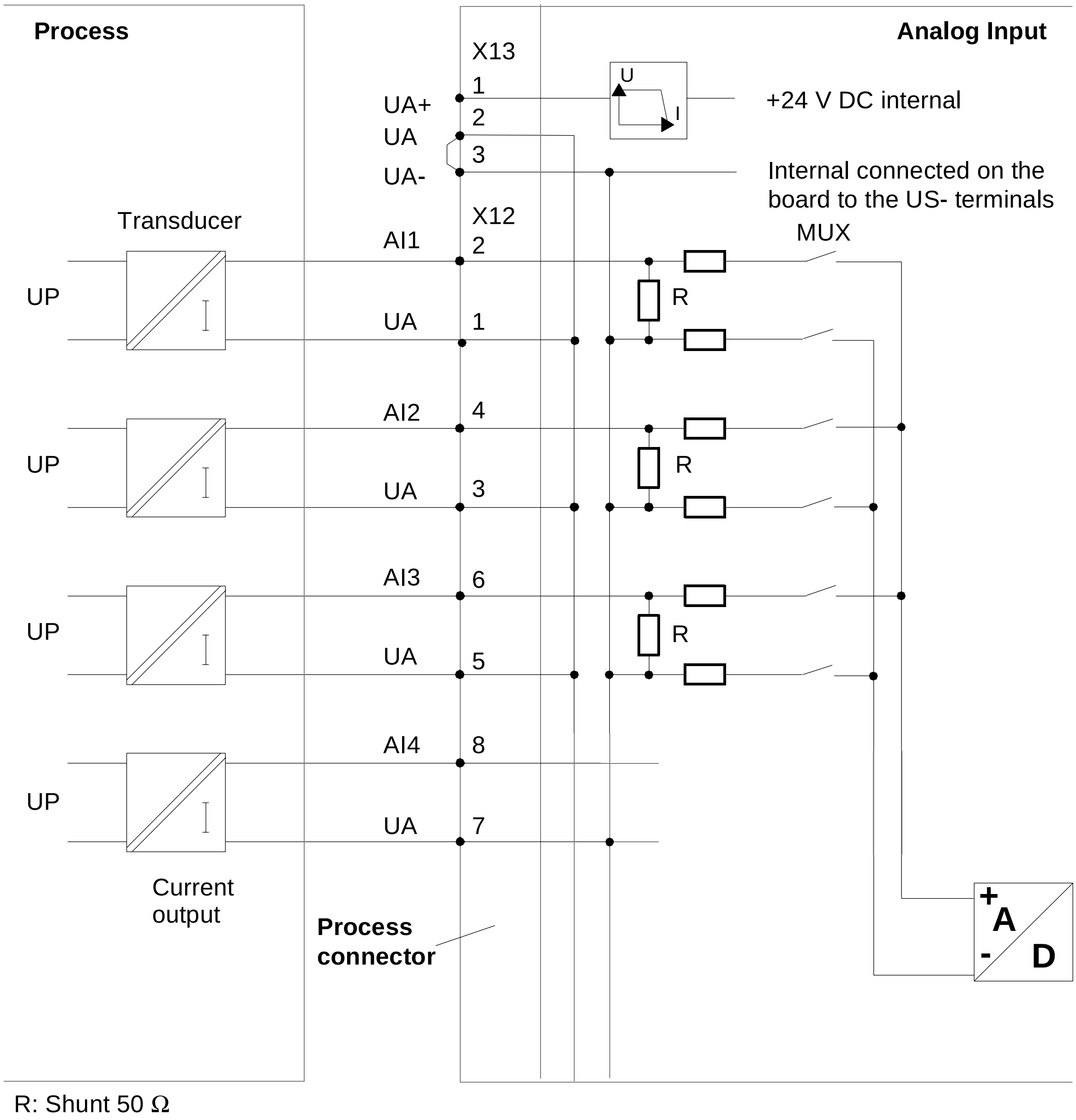


*Figure 4-23. Example of Connection of Analog Current Inputs for Active Transducers*

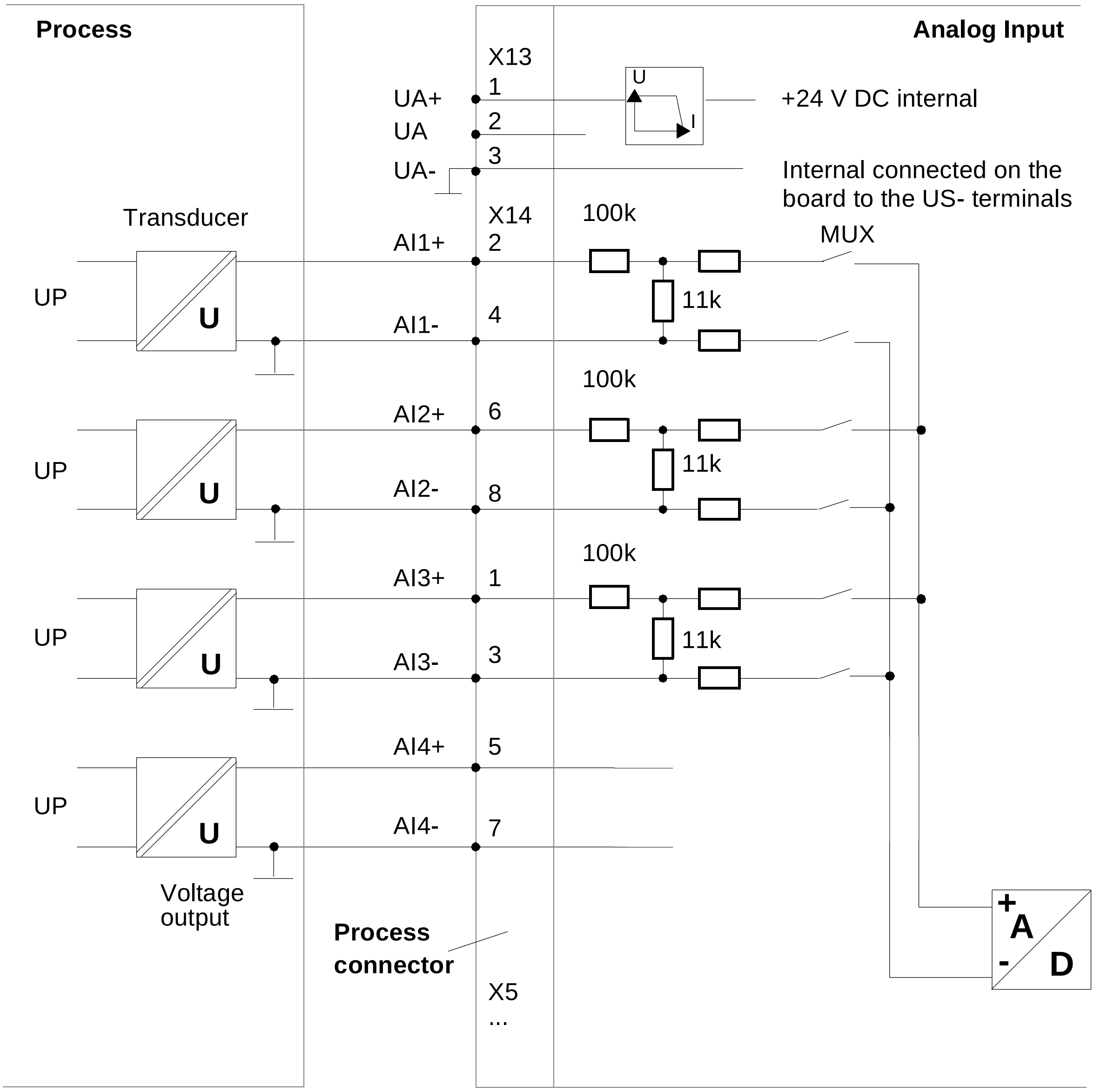


*Figure 4-24. Example of Connection of Analog Voltage Inputs for Isolated Transducers*

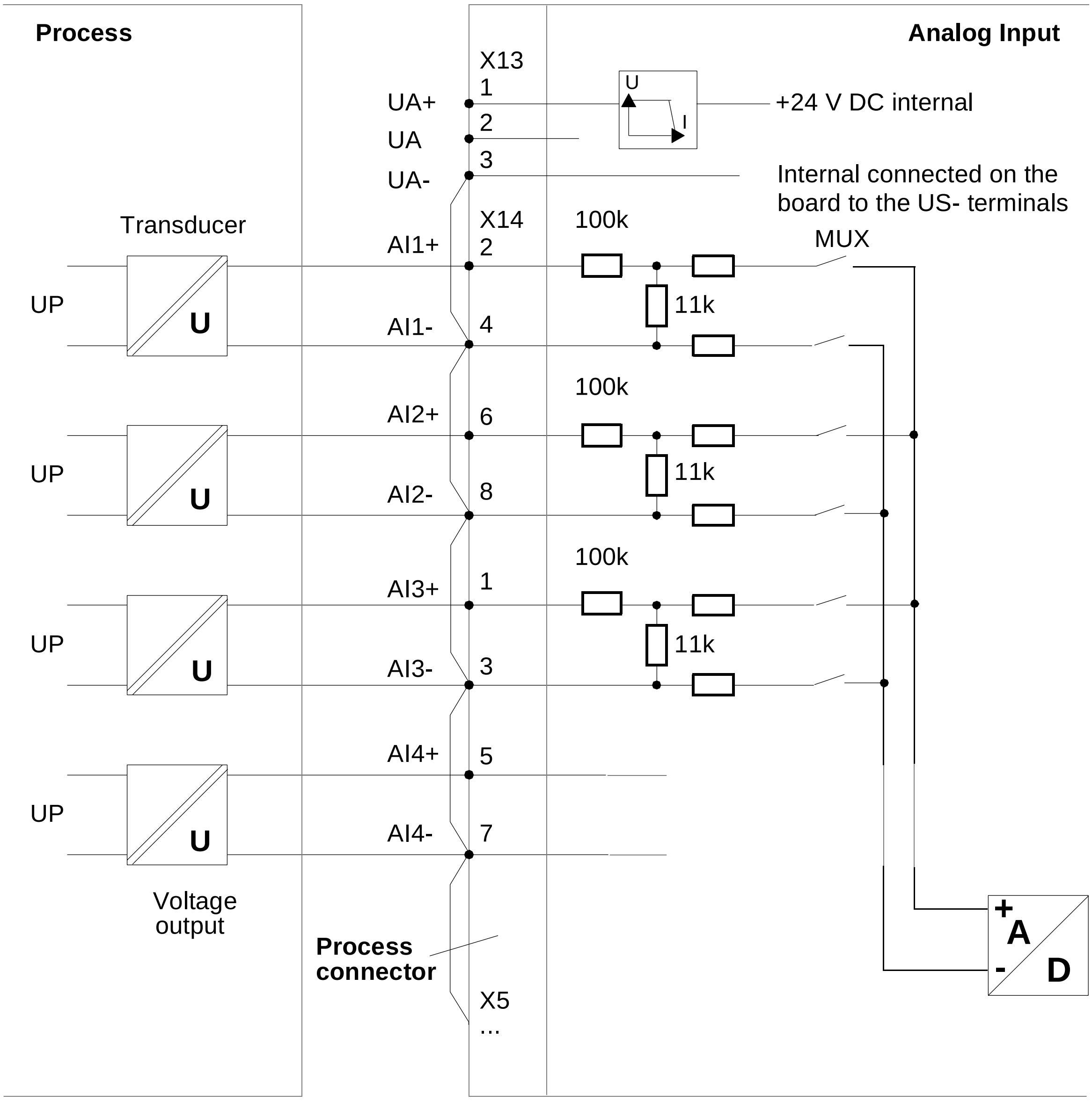


*Figure 4-25. Example of Connection of Analog Voltage Inputs for Non-isolated Transducers*

## 4.4.4 Analog Outputs

Analog outputs convert the digital signals from the programmable controller into the analog signals needed for controlling the process.

Basic or expansion units have two output channels which are not isolated from the electronic power supply and are not isolated from one another. The connections and functions of the analog outputs are the same for basic and expansion units. The channel outputs are current sources of 0 - 20 mA or 4 - 20 mA. The outputs are short-circuit and open-circuit proof.

A green LED (RUN) on the expansion units indicates that the I/O communication is operating normally. A red LED (F(FAULT)) signals a severe fault.

Figure 4-26 shows the block diagram of an analog output function.

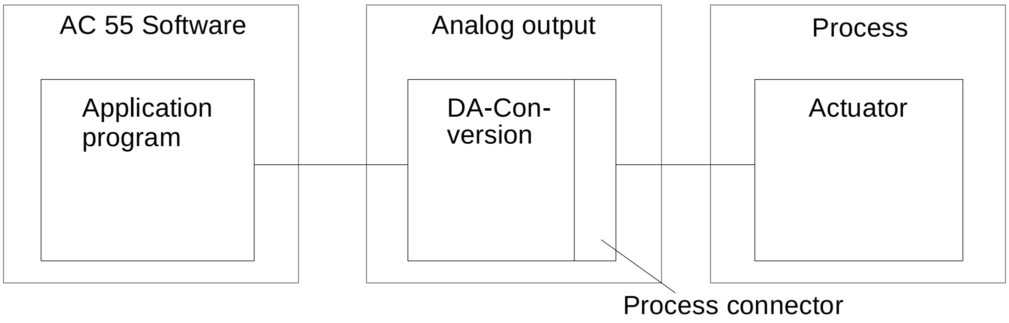


*Figure 4-26. Block Diagram of an Analog Output Signal*

During power-up, a hardware circuit forces all the outputs to "0" until the AC 55 programmable controller sets the outputs to the operating mode. The output circuits are supplied from the internal 24 V power supply.

If a severe fault in the corresponding unit is detected and the LED (F(FAULT)) on the front of the unit lights, an 'error' (ERR) is signalled at the corresponding unit's DB element.

### 4.4.4.1 Writing Analog Output Signals

An application program consisting of PC and DB elements runs cyclically in the Advant Controller 55 programmable controller. After the execution of a program module (for example, control module), the programmable controller writes the output values into a memory location.

An AO scan task reads the AO signals from the memory location, processes the AO signals (see below) and gives the result to the D/A converter. Each AO signal has its own D/A converter, so in every cycle of the AO scan task, all AO are output. The AO scan task has a cycle time of 200 ms.

## 4.4.4.2 Processing Analog Output Signals

The hardware and software signal processing of an AO signal involves the following procedures:

- Limitation to signal range
- Conversion of digital signal to analog signal

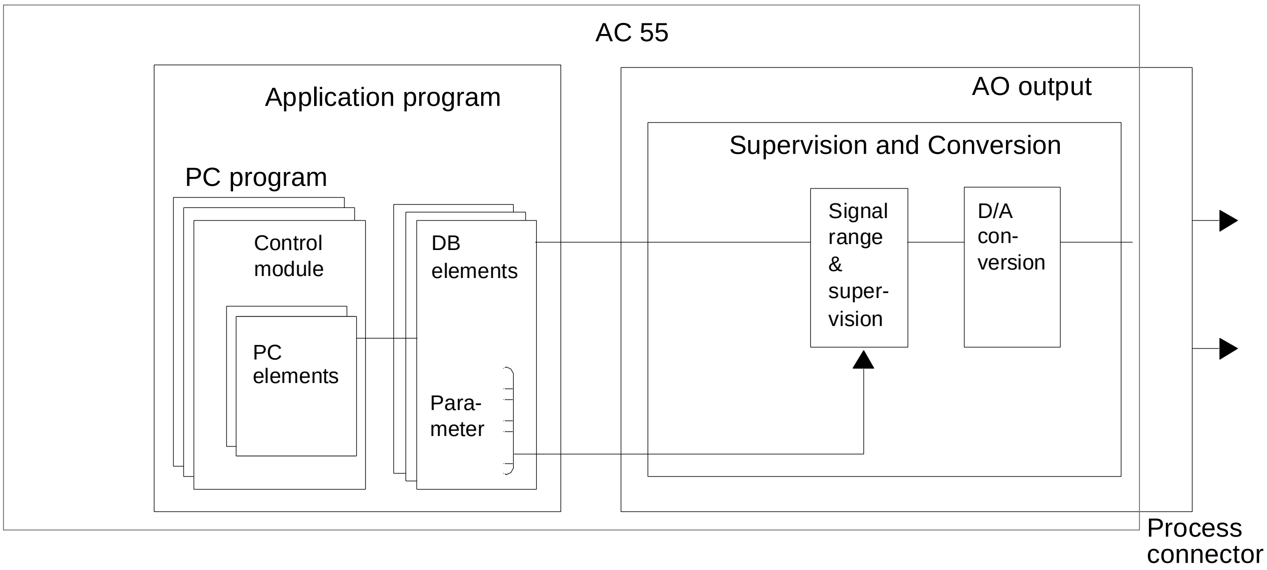


*Figure 4-27. Processing AO signals*

### Limitations to Signal Range

Excursions of the AO signal coming from a PC element outside its possible range are limited to the limits of the permissible range.

The analog output value is always represented in the application program by a percentage, that is, 100 corresponds to 20 mA and 0 corresponds to 0 mA in the range 0 - 20 mA, and 0 corresponds to 4 mA in the range 4 - 20 mA.

### D/A Conversion

Each output has its own D/A converter with a current output. The range is switched by means of software scaling.

### 4.4.4.3 Technical Data

*Table 4-4. Technical Data of Analog Outputs*

| Analog Output | All Units |
|---|---|
| No. of outputs | 2 per unit |
| Output range<br>Current output<br>Overrange (1) | 0 - 20 mA (1)<br>4 - 20 mA (1)<br>0 - 20,4 mA<br>4 - 20,4 mA |
| Load, current output | ≤ 500 Ohms |
| Analog output error<br>Maximum error at 25°C<br>Temp. coefficient for current | 0.2 %<br>0.008 %/°C |
| Resolution | 12 bit |
| Isolation | No |
| Scan cycle time | 200 ms |

(1) The output values are set to the corresponding limit value, if the digital values from the application program exceed the overrange.

### 4.4.4.4 Process Connection

The following figures show the front view of the connectors for analog outputs and the connection diagram. The connection diagrams for the basic unit and the expansion unit are the same.

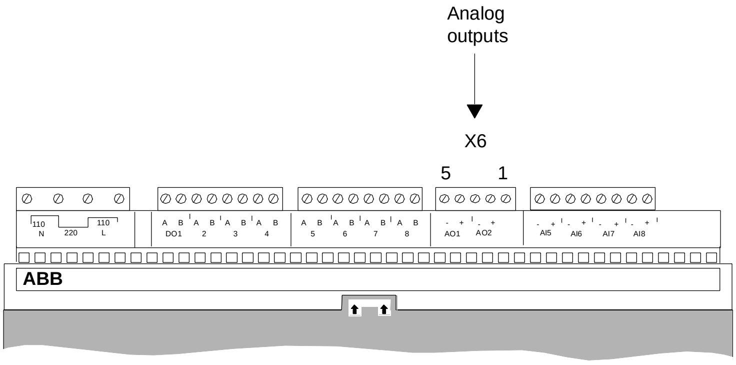


*Figure 4-28. View of the Connectors for Analog Outputs*

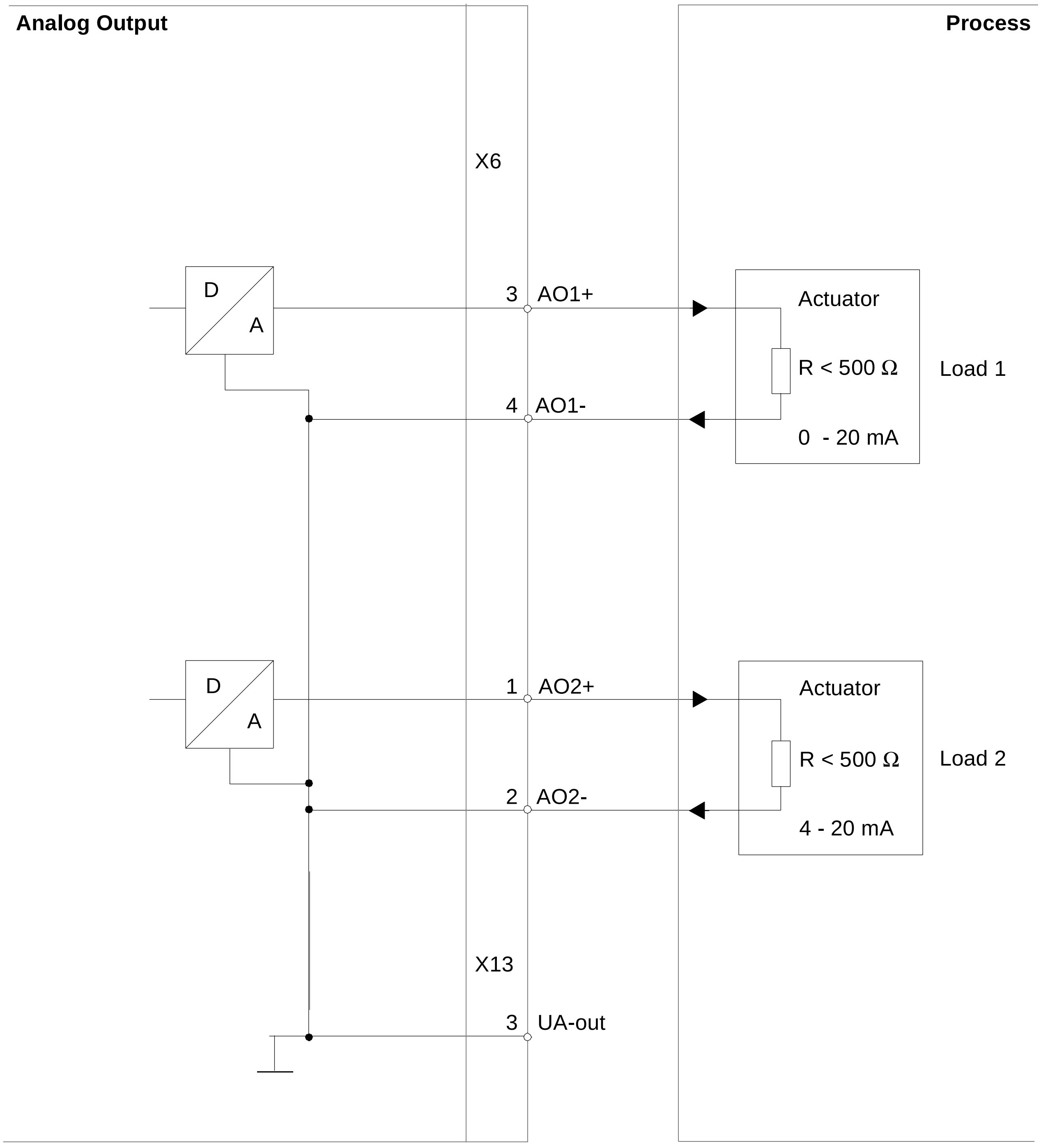


*Figure 4-29. Example of Connection to the Analog Outputs*

## 4.4.5 Digital Inputs

The units have 16 digital input channels. The connections and functions of digital inputs are the same for the basic and the expansion units. Opto-couplers isolate inputs from the system potential. Each input has a contact bounce filter. The status of the inputs is indicated by yellow LEDs located on the front of the module. The LEDs are driven by the AC 55 software.

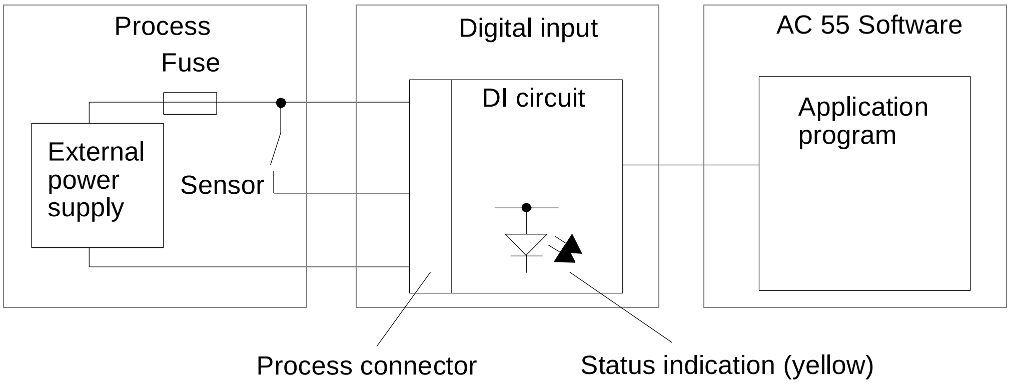


*Figure 4-30. Example: Block Diagram of the Digital Input*

A green LED (TP) on the front of each unit indicates that the internal and the internal or external digital analog transducer power supplies are ok. If the fuse for the digital process voltage supply is blown, the LED TP is not lighted and a ‘process voltage error’ (PVOLTERR) is signalled at the corresponding unit's DB element.

If a severe fault in the corresponding unit is detected, the LED (F(FAULT)) on the front of the unit lights and an ‘error’ (ERR) is signalled at the corresponding unit's DB element.

### 4.4.5.1 Reading Digital Input Signals

An application program consisting of PC and DB elements runs cyclically in the AC 55 programmable controller. Before the execution of a program module (e.g., control module), the CPU reads the input signals from a memory location. A DI scan task reads the signal from the digital input hardware, performs its processing and writes it into that memory location. The DI scan task has a cycle time of 10 ms. In every cycle of the DI scan task, all DI signals are processed.

## 4.4.5.2 Processing Digital Input Signals

The hardware and software signal processing of a DI signal involves the following procedures:

- Process signal level conversion.
- Potential isolation.
- HW filtering with constant filtering time.
- Setting the channel LED.

The following diagram shows how standard digital input signals are processed.

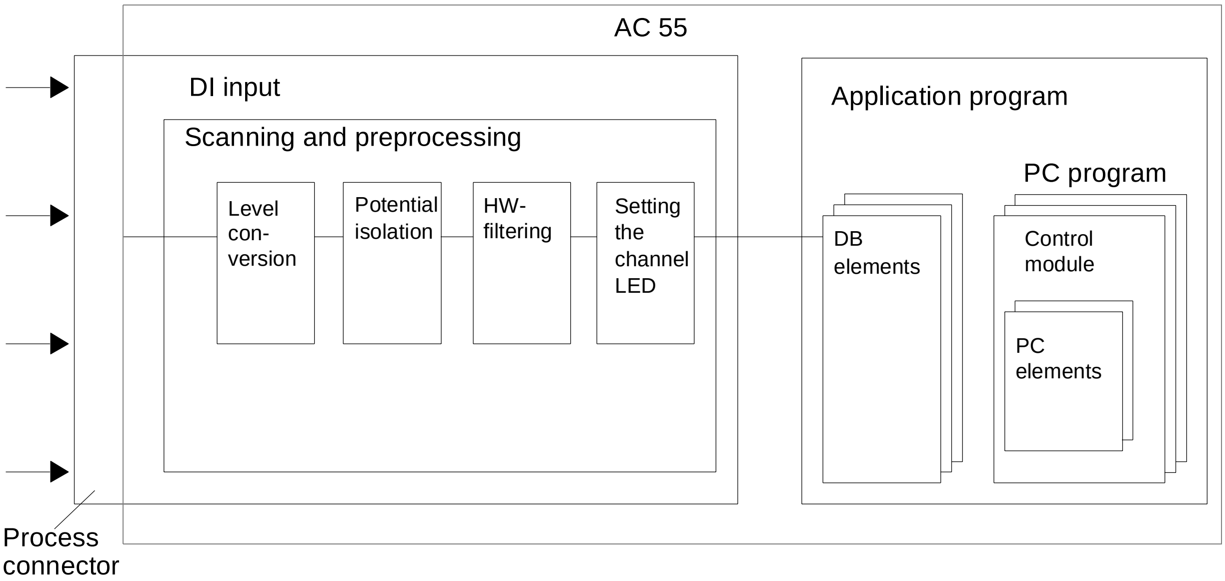


*Figure 4-31. Preprocessing DI Signals*

### Filtering

The input signals are filtered to suppress any electrical interference or contact bounce. The filtering time for all inputs is fixed at 8 ms.

### Functions of Digital Input

The 16 digital inputs are arranged in one group of 16 channels with a common return (DI- in). The group is isolated from the other I/O and from the electronic power supply. The units are available for external or internal process voltages of 24 V DC or 48 V DC.

### 4.4.5.3 Technical Data

*Table 4-5. Technical Data on Digital Input Modules*

| **Digital Input** | **CT481,CX473** | **CT482,CX475** |
|---|---|---|
| No. of inputs | 16 per unit | 16 per unit |
| Input voltage | | |
| - Rated voltage | 24 V DC | 48 V DC |
| DI (1) | | |
| - Input voltage range "0" | - 30 - + 5 V | - 6 - + 10 V |
| - Input voltage range "1" | +13 - + 30 V | +30 - + 60 V |
| Input current typ. | 8.3 mA | 5 mA |
| Power dissipation per channel (2) | 200 mW | 280 mW |
| Time delay (HW filtering) type (3) | 8 ms | 8 ms |
| Transducer supply voltage | Internal/external | Internal/external |
| Isolation | Yes | Yes |
| - in groups per - | 16 channels | 16 channels |
| - test voltage | 3100 VDC- | 3100 VDC- |
| Scan cycle time | 10 ms | 10 ms |

(1) In accordance with standards IEC 65A type 1 (current and voltage) and IEC 65A type 2 (voltage)

(2) Total power dissipation at rated supply voltage.

(3) Additional software filtering optional, see previous sections.

### 4.4.5.4 Process Connection

The following figures show the front view of the connectors for digital inputs and the connection diagram. The connection diagrams for the basic unit and the expansion unit are the same.

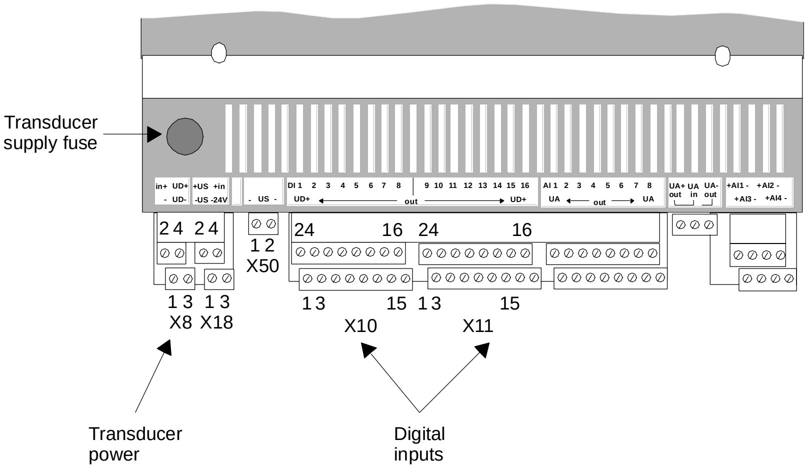


*Figure 4-32. View to the Connectors of the Digital Inputs*

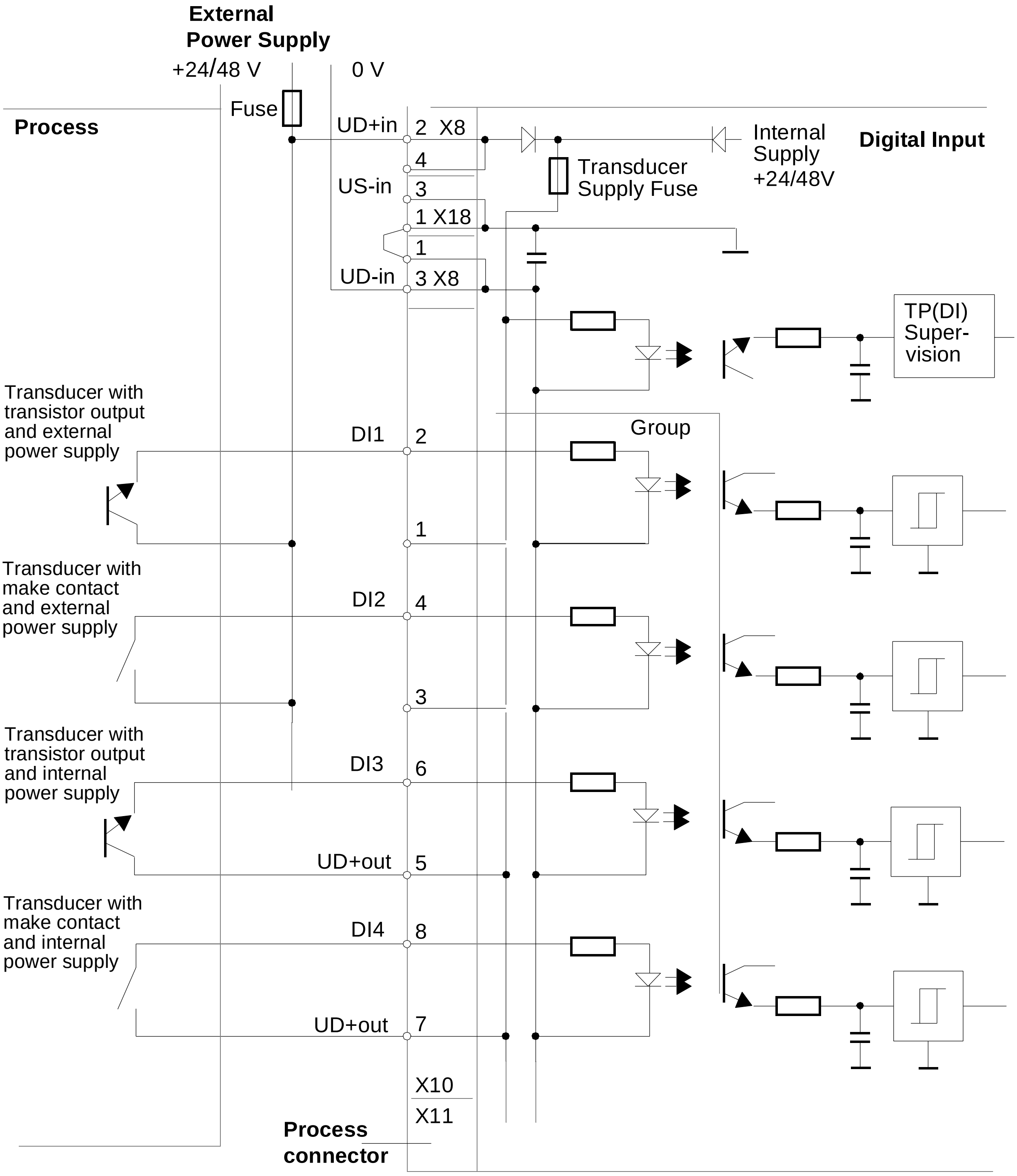

External Power Supply
+24/48 V
0 V
Process
Fuse
UD+in
2 X8
4
US-in
3
1 X18
1
UD-in
3 X8
Transducer Supply Fuse
Internal Supply +24/48V
Digital Input
TP(DI) Super-vision
Transducer with transistor output and external power supply
DI1
2
1
Group
Transducer with make contact and external power supply
DI2
4
3
Transducer with transistor output and internal power supply
DI3
6
UD+out
5
Transducer with make contact and internal power supply
DI4
8
UD+out
7
X10
X11
Process connector

*Figure 4-33. Example of Connecting the Digital Inputs*

## 4.4.6 Digital Outputs

The units have eight digital output channels. The connections and functions of the digital outputs are the same for the basic unit and the expansion unit.

The internal circuit converts the binary signals of the programmable controller into the binary signal levels required to control the process. The status of the outputs is signaled by yellow LEDs on the front of the units. The LEDs are driven by the AC 55 software.

If a severe fault, e.g., faulty internal 24 V for control of the output relays, is detected, the mode changes to “ERROR,” the LED (F(FAULT)) on the front of the unit lights and the outputs are set to “0.”

The output circuits of the modules consist of a number of outputs with register of output data. Logical “1” corresponds to an active output.

After powering up, all outputs are switched off (logical “0”) and remain so until the Advant Controller 55 programmable controller sets the outputs to the operating mode. In the case of severe faults, the outputs remain switched off.

The output circuits (relay contacts) must be supplied by an external process voltage.

### 4.4.6.1 Writing Digital Output Signals

An application program consisting of PC and DB elements runs cyclically in the AC 55 programmable controller. After the execution of a program module (e.g., control module), the programmable controller writes the output values to a memory location. This is performed by a “read - modify - write” procedure, i.e., output registers are read-back and/or combined with the new values and written to the output module. These outputs can be used individually by control modules.

A DO scan task reads the DI signals from the memory location, processes them and writes them to the hardware register, which is connected to the relay. The DO scan task has a cycle time of 10 ms.

### 4.4.6.2 Processing Digital Output Signals

The hardware and software signal processing of a DO signal involves the following procedures:

- Setting the output channel status LED.
- Control of the output relay.

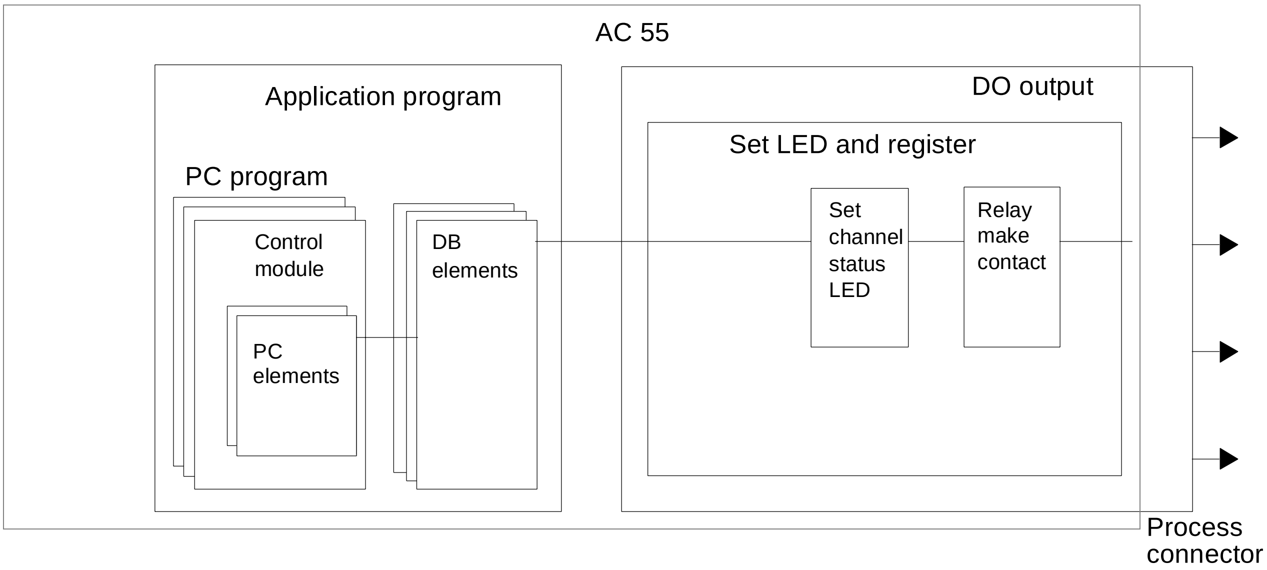


*Figure 4-34. Processing DO Signals*

**Digital Output**

Each unit has eight digital relay outputs. Since the outputs are isolated from each other, up to eight different external power supplies can be used.

### 4.4.6.3 Technical Data

*Table 4-6. Technical Data on Digital Outputs*

| Digital Output | All Units |
|---|---|
| No. of outputs | 8 |
| Breaking voltage | 16...250 V AC / DC |
| Load current, max.<br>Load current, min.<br><br>Breaking capacity max. at DC<br>Breaking capacity max. at AC | 3A<br>100mA at 24 V DC<br>or 2,5 VA min.<br>44W at L/R<40ms<br>720VA at cosϕ >0,4 |
| Type of output | Relay<br>Make contact |
| Life expectancy of the relays<br>- resistive load 220VAC/8A<br>- inductive load 220VAC/3A<br>at cosϕ =0,5 | <br>$>2*10^5$switch cycles<br>$>3*10^5$switch cycles |
| Short-circuit protection | No |
| Isolation<br>- in groups per<br>- test voltage | Yes<br>2 poles per channel<br>3100 V DC |
| Scan cycle time | 10 ms |

The following figures show the front view of the connectors for digital outputs and the connection diagram. The connection diagrams of the basic unit and the expansion unit are the same.

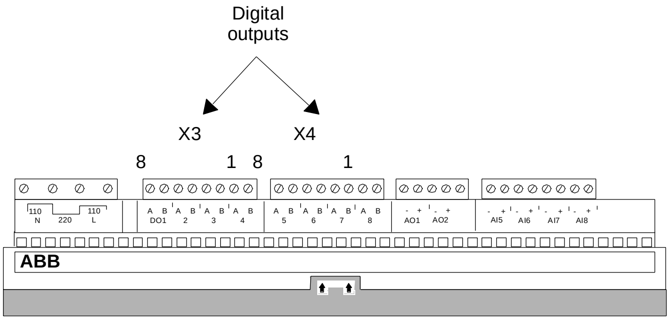


*Figure 4-35. View of the Connectors for Digital Outputs*

## 4.4.6.4 Process Connection

The following figure shows the digital outputs connection diagram.

All outputs are provided with isolated make relay contacts.The outputs are grouped in two separate eight-pole terminal groups

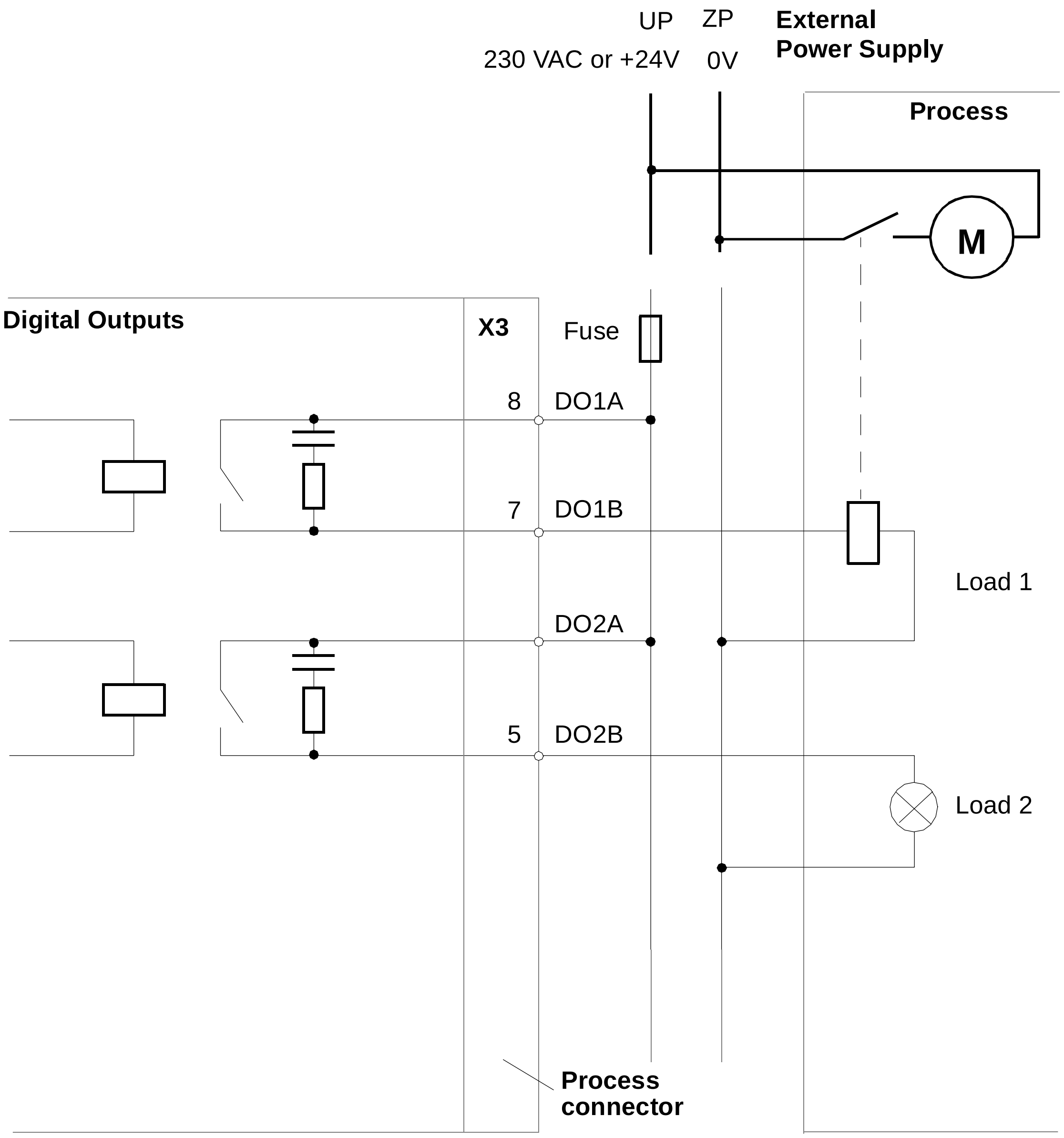


*Figure 4-36. Example of Connecting the Digital Outputs*

# 4.5 Serial Interfaces

## 4.5.1 General

The AC 55 basic unit CT481 or CT482 is equipped with two CCITT V. 24 (RS232-C) asynchronous communication channels.

The first channel is used for standard interfacing with the engineering station AS 100 ES. The second channel is used for transmission of process data and event data via a telecommunication line in RCOM point-to-point and multidrop connections. It provides the RCOM protocol. Standard modems can be connected with standard cables.

## 4.5.2 Configuration

Possible configurations are as follows:.

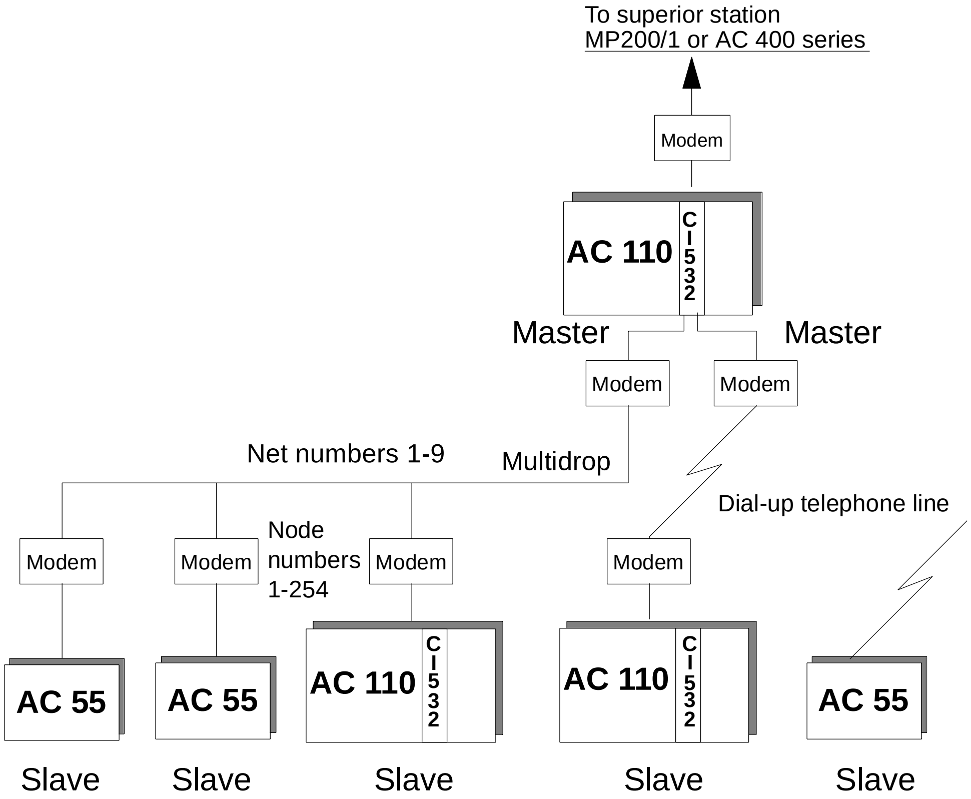


*Figure 4-37. Configuration Example with Advant Controller 55 as Slave*

Each station in the system must have a unique node number between 1 and 254. The net numbers are between 1 and 9. The configuration attributes are represented by the DB elements CT481 or CT482, MVICHAN, MVINODE and MVB. Please refer to the *RCOM Advant Controller 55 User' s Guide* for a detailed description.

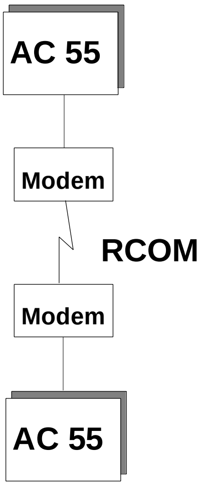


*Figure 4-38. Advant Controller 55 used as Master and Slave*

### 4.5.3 Communication

Communication between the Advant Controller stations via RCOM is managed by MVI Data Block elements MVB. Please refer to the *RCOM Advant Controller 55 User’s Guide* for a detailed description.

After power-on, the interface is in its initial (passive) state—no process data is sent or received and no time synchronization is done. After the CPU activates the programmed configuration (LED RUN is lit), data exchange can start.

The interface is used for RCOM communication with other units in a proprietary, local control network. Valid network numbers for a local network are 1 to 9. The AC 55 and every RTU (slave) connected to RCOM must have a node number, 1 to 254 (1 to 99 if connected to AdvaSoft for Windows via RCOM), which is unique within the control networks. The setup for the channel is made with a DB element MVICHAN using the Advant Station 100 Series Engineering Station.

You do not need to set up any jumpers or switches for RCOM.

### 4.5.4 Bus Master Function

The RCOM network is a bus with one bus administrator node. Data transfer on the bus is controlled by the bus master through polling of the bus nodes. The bus master function is permanently associated with a specific node. Advant Controller 55 can be the bus master.

## 4.5.5 Time Synchronization

The time synchronization function enables cyclic or single synchronization of the internal clocks of the Advant Controller stations within one RCOM network. The precision depends on the frequency of the clock-setting via RCOM, e.g., for clock-setting every hour, you get an accuracy level of 1.5 seconds.

The TIMESYNC terminal at DB element MVICHAN defines the mode of time synchronization.

- NONE: Time synchronization is disabled (sending as well as receiving) and time must be set via a programming tool.
- MASTER: The station is time synchronization master (sending) and correct time must be set via a programming tool. An MVI channel works as time synchronization master if the terminal MASTER has the value 1 and the terminal TIMESYNC has the value MASTER. After receiving a time and date broadcast from the CPU, it transmits time and date automatically via RCOM in a way which is determined by the MVICHAN DB element.
- SLAVE: The station is time synchronization slave, time telegrams are received via RCOM and the internal clock is adjusted to the internal time of the time synchronization master. Setting of time via a programming tool is not possible.

## 4.5.6 Supervision

The supervision function detects communication errors or status as follows.

If no fatal errors are present, the communication interface is set to operational (by the CPU). The DB element MVICHAN must show the following when the link is connected:

- DSR = 1
- CTS = 1 (full duplex) or toggling between I and O (half duplex)
- DCD = 1 (full duplex) or toggling between I and O (half duplex)
- ERR = 0

When the link to an RTU is connected and transferring data, the following applies for the terminal Status1 of the DB element MVINODE for the corresponding slave node:

- Link Status (bit 0) = l
- Line Status (bit 1) = l in telephone mode.

Please refer to the *RCOM Advant Controller 55 User’s Guide* for a detailed description.

## 4.5.7 Technical Data

*Table 4-7. Communication Interface Technical Data*

| Communication Interface | Channel1 | Channel2 |
|---|---|---|
| Type | RS232C | RS232C |
| Potential isolation | Yes | No |
| No. of pins used | 3 | 9 |
| Male/female | Female | Male |
| Signals supported | TXD,RXD,GND | TXD,RXD,GND<br>RTS,CTS,DTR,<br>DSR,DCD,RI |

## 4.5.8 Module Front

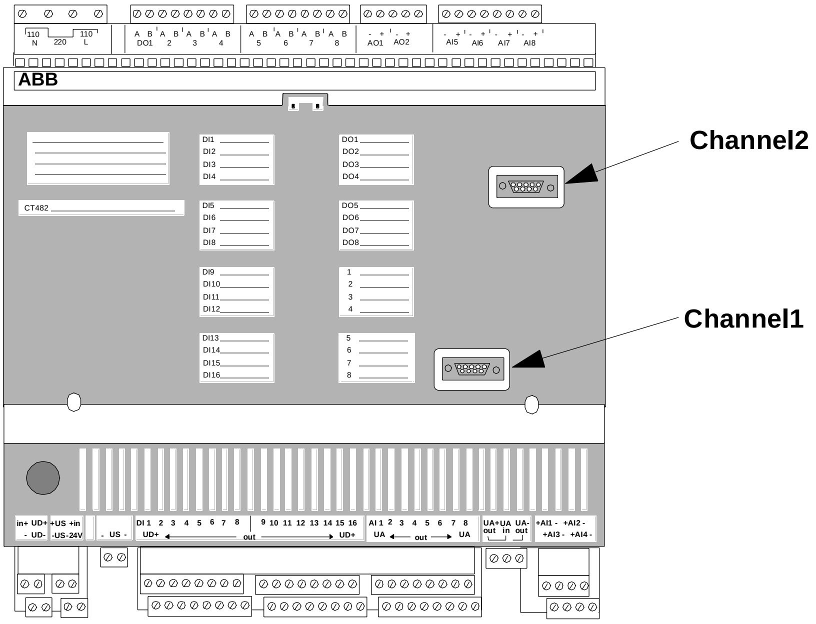


*Figure 4-39. AC 55 Basic Unit CT481 or CT482 with Two Serial Interfaces*

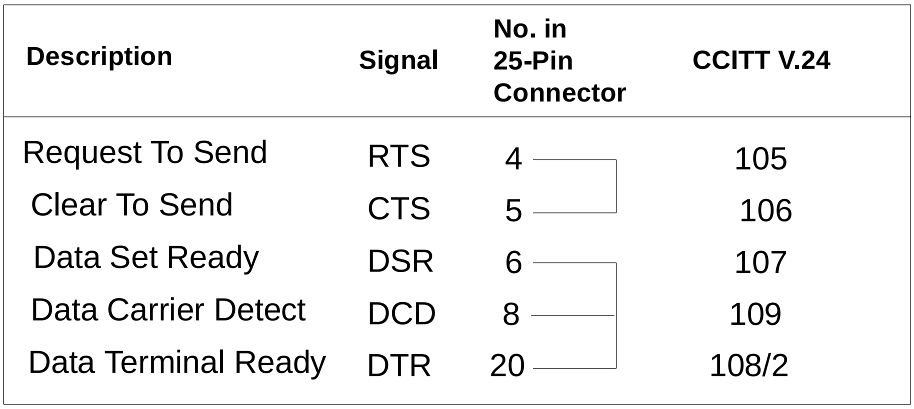
*Table 4-8. Description of Channel1 Connections.*

| Description | Signal | No. in 9-Pin Connector | CCITT V.24 | Direction |
|---|---|---|---|---|
| Transmit Data | TD | 2 | 103 | → |
| Receive Data | RD | 3 | 104 | ← |
| Signal Ground | SG | 5 | 102 | ↔ |

*Table 4-9. Description of Channel2 Connections according to CCITT V.24*

| Description | Signal | No. in 9-Pin Connector | No. in 25-Pin Connector | CCITT V.24 | Direction |
|---|---|---|---|---|---|
| Data Carrier Detect | DCD | 1 | 8 | 109 | ← |
| Receive Data | RD | 2 | 3 | 104 | ← |
| Transmit Data | TD | 3 | 2 | 103 | → |
| Data Terminal Ready | DTR | 4 | 20 | 108/2 | → |
| Signal Ground | SG | 5 | 7 | 102 | ↔ |
| Data Set Ready | DSR | 6 | 6 | 107 | ← |
| Request To Send | RTS | 7 | 4 | 105 | → |
| Clear To Send | CTS | 8 | 5 | 106 | ← |
| Ring Indicator | RI | 9 | 22 | 125 | ← |

When you use modems for point-to-point connections without control signals, the modem cable must be wired for full duplex handling of modem signals, as shown in the Figure 4-40. When you use standard modems, no extra wiring is necessary.



| Description | Signal | No. in 25-Pin Connector | CCITT V.24 |
|---|---|---|---|
| Request To Send | RTS | 4 | 105 |
| Clear To Send | CTS | 5 | 106 |
| Data Set Ready | DSR | 6 | 107 |
| Data Carrier Detect | DCD | 8 | 109 |
| Data Terminal Ready | DTR | 20 | 108/2 |

*Figure 4-40. Necessary Wiring in the Cable when a Modem without Control Signals is used*

The further information concerning modems and cables, please refer to the *RCOM Advant Controller 55 User’s Guide*.

# Chapter 5 Hardware Planning and Installation

## 5.1 Mechanical Installation and Wiring

The following sections contain recommendations and instructions for installing and connecting the Advant Controller 55.

All electrical installation work must be performed in accordance with national safety regulations and the safety rules for the ABB Advant System.

## 5.1.1 Safety Regulations

Always observe the following instructions when operating an Advant Controller 55 system to minimize the risk of injury to personnel and damage to the equipment. Any local statutory regulations which are more stringent than those set out below take precedence.

### 5.1.1.1 Personnel Safety

Observe the following instructions:

- Always take special care when working on the equipment with the supply connected. The voltage in the cabinet can be dangerous.
- Everyone who works on the equipment must know the location of the main power switch of the Advant Controller 55 and how it is operated.
- Never connect the process connector carrying signals from the field to a unit if the unit is not mounted and is not properly connected and earthed.
- A responsible person must perform follow-up checks on, and test runs of, parts of the process, interlocking chains, etc. Warn all erection personnel before any test runs are performed.
- Engineers responsible for the process plant must be present when the process equipment and machines are tested and operated.
- Never select the system INIT without knowing what actions are carried out by the system initialization procedure.
- Remember that you can control the system via RCOM from a superior station (for example, AC 110).
- Remember that an Advant Controller 55 starts automatically when voltage is applied. You can prevent start-up of an Advant Controller 55 when the auxiliary supply is switched on by setting the START MODE switch to the STOP position 1.

## 5.1.2  Description of Advant Controller 55 Station Mechanical Design

The individual mechanical parts of the Advant Controller 55 station and their function and handling are described in the following sections.

### 5.1.2.1  Mounting

Advant Controller 55 can be mounted directly on a wall, on a mounting panel or on two DIN rails. An expansion unit, if used, must be as close as possible to the basic unit. The maximum distance allowed between the units is 40 mm using the standard connection cable. For greater distances, use the expansion unit cable GVR1908212 R1.

The basic and expansion units must be connected to the same ground before they are connected to each other (see Section 5.1.4.6, Earthing).

### 5.1.2.2  Mounting on a Wall or Panel

Make holes as illustrated in Figure 5-1. The distance between the basic unit and the expansion unit will then be approximately 2 mm.

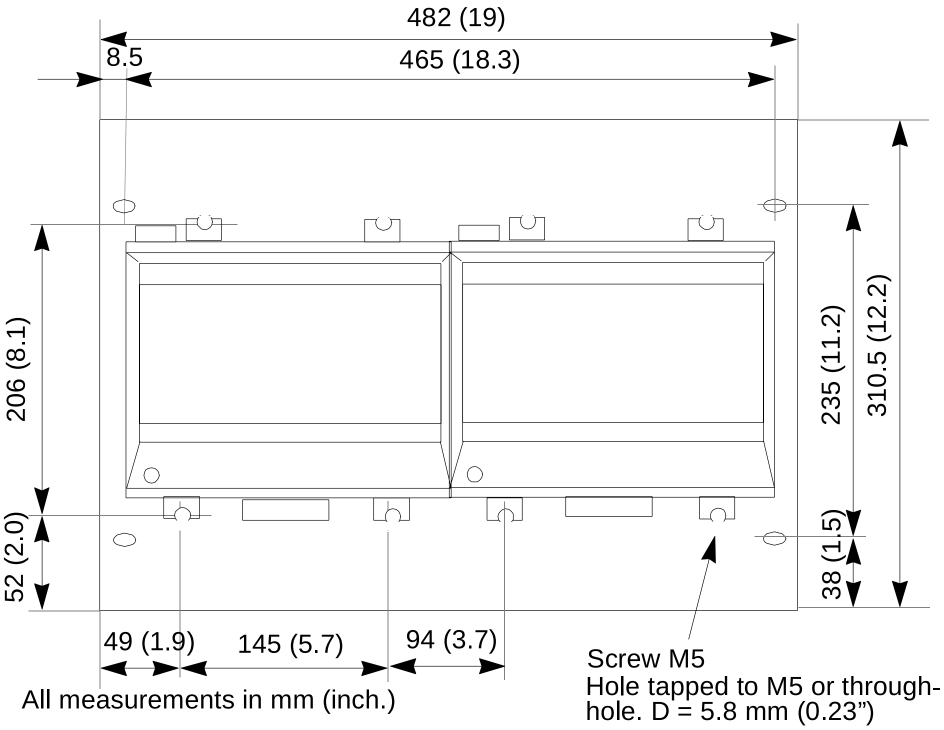
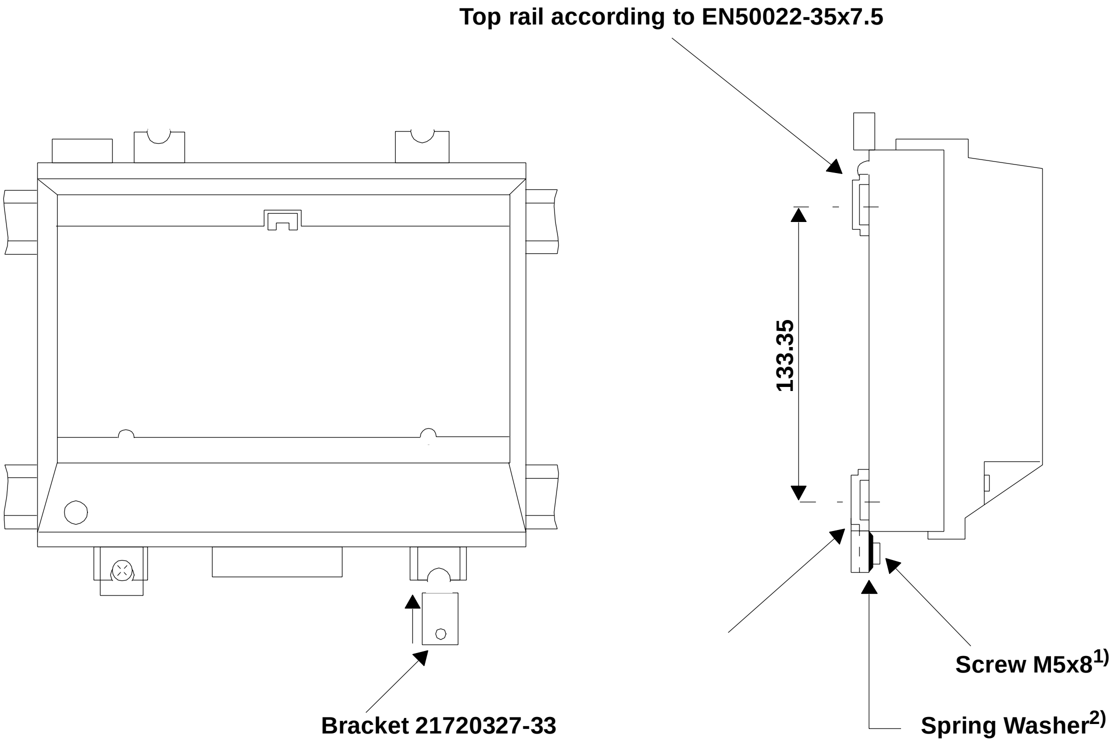


*Figure 5-1. Mounting Basic Unit and Expansion Unit Side by Side on a Wall or 19-inch Panel*

### 5.1.2.3 Mounting on DIN Rails

Use top rails according to EN 50022-35x7.5 with a center distance of 133.35 mm. (GJI 2322218R000, SZ-SI 45.460)



1) Screw DIN 7985-M5-6c x 8-K-4.9 A3G GNGN 491109 P606
2) Spring Washer DIN 137-B5-Fst A3G NB 336 174 P561

*Figure 5-2. Mounting on DIN Rails*

### 5.1.2.4 Mounting with Additional Expansion Units

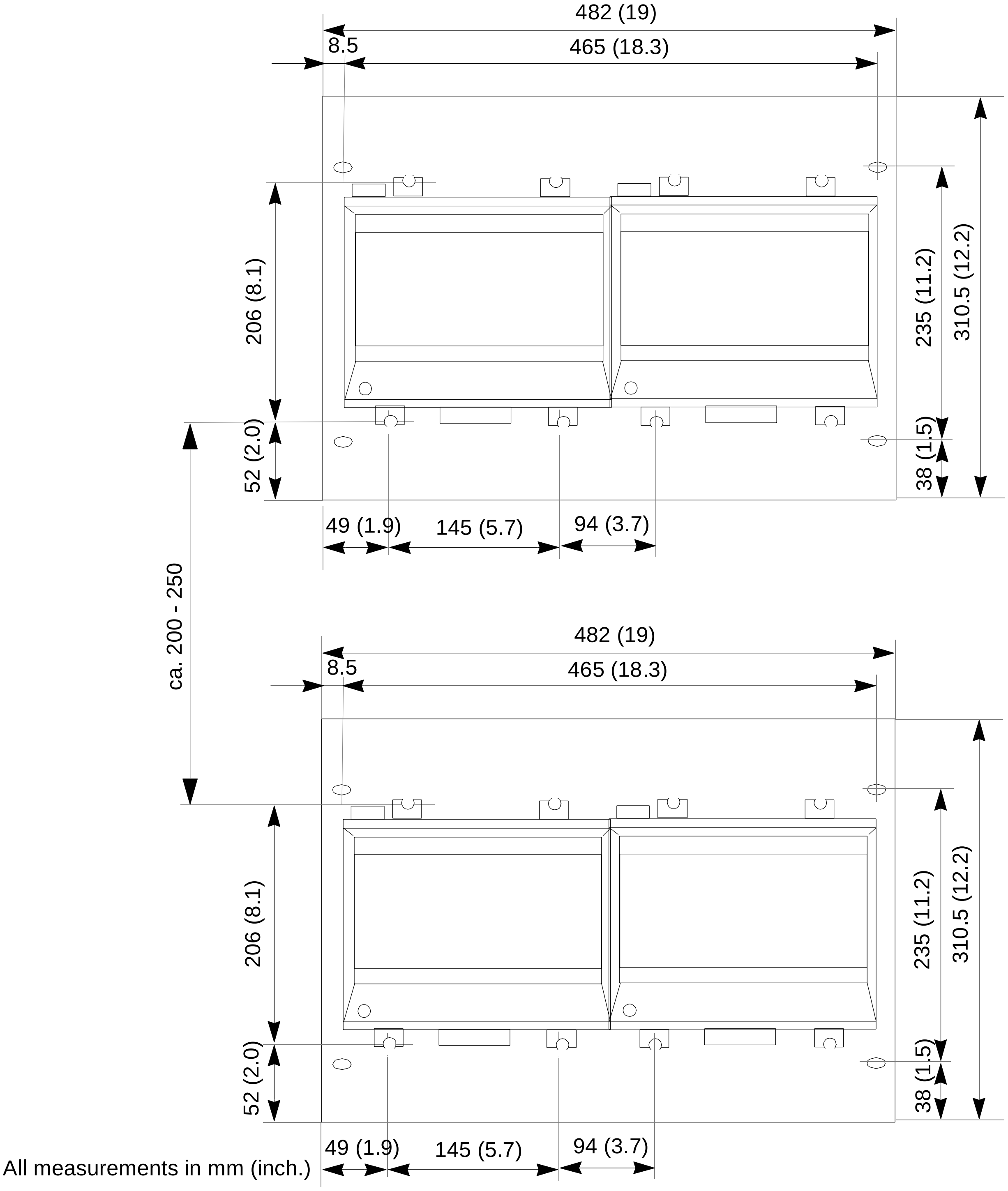


*Figure 5-3. Mounting with Additional Expansion Units*

### 5.1.2.5 Advant Controller 55 Station

The expansion possibilities for Advant Controller 55 are as follows.

Basic unit with **up to four expansion units** in **one** cabinet or box:

| | | |
|---|---|---|
| • | Digital inputs | up to 5 * 16 = 80 |
| • | Analog inputs | up to 5 * 8 = 40 |
| • | Digital outputs | up to 5 * 8 = 40 |
| • | Analog outputs | up to 5 * 2 = 10 |

## 5.1.3 Installation without a Cabinet

You can install the Advant Controller 55 without a cabinet. From the EMC and electrical safety point of view, the system works properly under industrial environmental conditions. For information on the environmental conditions for an Advant Controller 55 system (climatically and mechanical and electrical environment), see the *Installation Rules Reference Manual*.

Enclosure protection class of the Advant Controller 55 units: IP 20.

## 5.1.4 Installation in a Cabinet or Box

### 5.1.4.1 Mechanical Requirements

The Advant Controller 55 is intended to be mounted in one cabinet or box.

Recommended space inside the cabinet for different configurations is as follows.

| | | | |
|---|---|---|---|
| • | One unit: | 140 (90) mm x 240 mm x 240 mm | (D x W x H) |
| • | Two units: | 140 (90) mm x 482 mm x 240 mm | (D x W x H) |

The depth of 140 mm (ca.) depends on the plugs and cables used for the modem connection (serial interface Channel2). If no modem cable is connected, the depth is 90 mm.

### 5.1.4.2 Thermal Requirements

The thermal requirements a cabinet must fulfill depend on the following.

| | | |
|---|---|---|
| • | Max. power dissipation per unit: | 13 Watts basic unit, 6 Watts exp. unit |
| • | Max. ambient temperature of the units: | 60°C |
| • | Max. ambient temperature of the cabinet: | 40°C |

### 5.1.4.3 Cabinet Conductivity

The EMC of the Advant Controller 55 is designed for an industrial environment. For this reason, there are no special requirements with respect to cabinet conductivity and shielding in order to achieve high EMC in an industrial environment.

### 5.1.4.4 Cabinet Location

You must install the Advant Controller 55 in strict accordance with this manual and the drawings provided with the equipment. The following are supplementary instructions.

An Advant Controller 55 station is not confined to any particular type of cabinet. You can use standard cabinets (600 x 750 x 2300 mm) as well as other types of cabinets. The minimum inside cabinet depth required by an Advant Controller 55 station is ca. 140 mm.

You must bolt or weld the cabinet to a stable floor, deck or supporting structure which is not subject to vibration. Effectively earth the cabinet and remove all units before performing any welding work.

The distance between the top of the cabinet and the ceiling or any ventilation duct, etc., must be at least 150 mm. When the cables enter the cabinet from above, the space required above the cabinet will also depend on the type of cable and the method of installation. The distance between the sides and rear of a cabinet and the walls must be at least 40 mm.

### 5.1.4.5 Requirements to be Fulfilled by a Cabinet

The following sections contain the requirements a cabinet must fulfill before it is acceptable for installation of an Advant Controller 55.

### 5.1.4.6 Earthing

The Advant Controller 55 must be bonded to the same ground as the high-voltage plant, which must be capable of absorbing interference voltages generated in the plant itself or by a lightning strike.

Ground faults on the high-voltage plant can produce heavy currents, which lead to voltage drops of considerable amplitude across the grounding system. The corresponding field strengths must not exceed 1 - 4 V/m.

### 5.1.4.7 Grounding and Cabinet Power Inlet

**Nonconductive Cabinet**

- When using a nonconductive cabinet, you must earth the units with a copper conductor of at least 35 $mm^2$ (AWG 2).
- The cabinet may be equipped with a power outlet for plugging in peripheral units. The PE conductor must be copper with a gauge of at least 2.5 $mm^2$ (AWG 14) and must be connected to the power inlet (power distribution) of the cabinet.
- The same grounding rules apply as those given in Section 5.1.4.9, Screening and Grounding.

**Conductive Cabinet**

- When using a conductive cabinet, you must mount the Advant Controller 55 either on a conductive panel or on conductive rails to ensure the system has a stable ground potential. The conductivity of the electrical contact to the cabinet must be reliable under all circumstances both for safety and EMC reasons.
- The cabinet must have at least one screw terminal for a protective earth conductor. Every isolated conductive part of the cabinet, which in the event of a fault can assume a voltage to ground, must be connected to protective earth by its own protective conductor (safety rule).
- The cabinet must be earthed by a protective earth conductor having a gauge of at least 35 $mm^2$ (AWG 2) (see Figure 5-4). The grounding/earthing cables must be as short as possible.
- The plant earth potential must be stable and well-defined, even in the event of ground fault in either a low- or high-voltage plant or in the event of a lightning strike.
- The cabinet may be equipped with a power outlet for plugging in peripheral units.
  The conductors must be copper with a gauge of at least 2.5 $mm^2$ (AWG 14) and must be connected to the power inlet (power distribution) of the cabinet.

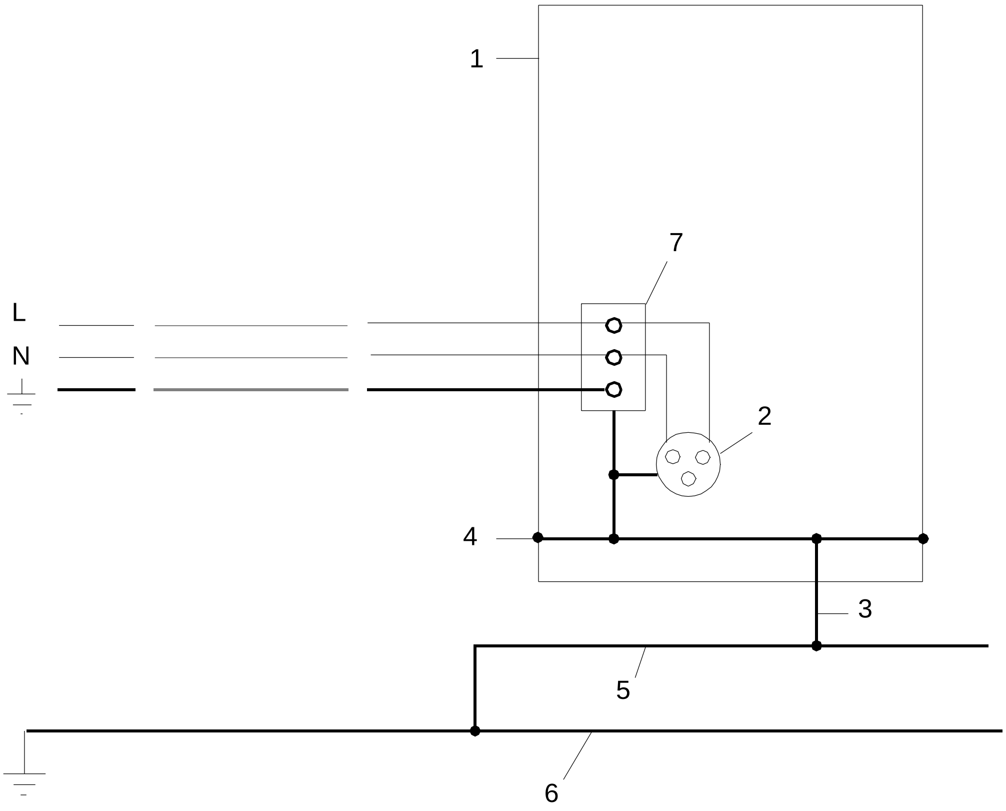


*Figure 5-4. Cabinet Grounding*

1. Cabinet
2. Power outlet (e.g., for AS 100ES)
3. Main protective earthing bar
4. Plant ground
5. Protective earth conductor 35 mm$^2$
6. Protective earth conductor
7. Power distribution.

#### 5.1.4.8 Mounting Holes

The mounting holes are in accordance with Figure 5-1.

#### 5.1.4.9 Screening and Grounding

The Advant Controller 55's internal circuits are grounded to the equipment frame, which is the reference ground for all suppression of external signal noise. If grounding is not properly carried out, the system is sensitive to HF interference and voltage spikes generated by unsuppressed relays and contacts as well as electrostatic discharges. If the Advant Controller 55 is installed in a conductive cabinet as described here, the cabinet must be bonded to ground potential, which forms an additional screen around the Advant Controller 55.

The plant ground potential must be stable and well-defined even in the event of ground fault in either a low- or high-voltage plant or in the event of a lightning strike.

The cabinet must be grounded by a copper conductor having a gauge of at least 35 $mm^2$ connected to the main protective earthing bar in the bottom of the cabinet, to which the screen grounding bar is also connected (see Figure 5-4).

## 5.2 Power Supply

## 5.2.1 Station Voltage

All Advant Controller 55 units used in the configuration must be supplied from the same source.

(Refer to the manual *Interference-free electronics* for more information on power supplies.)

Advant Controller 55 may be supplied with three different standard voltages:

Input: 230 V AC nominal
115 V AC nominal
24 V DC nominal

These voltages are valid for the basic and expansion units.

#### 5.2.1.1 Power Terminals and Cable Routing

When several units are used for the same station (basic and expansion units), the connection of the station voltage terminals of the units must be parallel (see Figure 5-5).

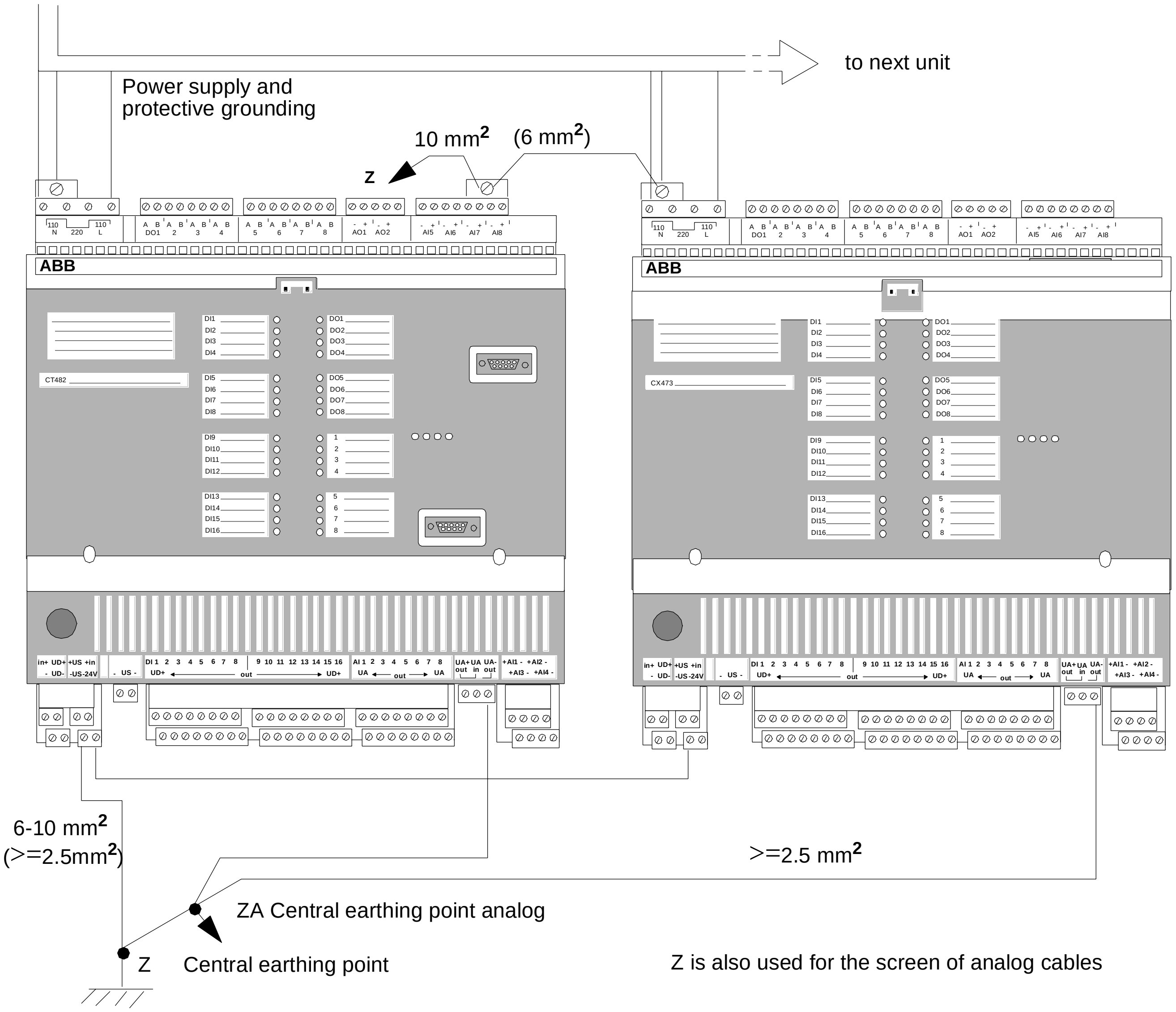


*Figure 5-5. Interconnecting the Station Voltage Terminals of two Units of AC 55 and Earthing*

## 5.2.2 Process Voltage

The process voltage differs depending on the type of input and output modules used. See the following sections for the requirements the process voltage must fulfill.

### 5.2.2.1 Mains Process Voltage

The digital outputs have a nominal process voltage of 230 V AC. The process voltage can be taken directly from the mains of the cabinet.

Refer to the digital output description for details of voltage tolerances, etc.

### 5.2.2.2 Process Voltage from a Power Supply Unit

An adequately rated power supply unit connected to the mains is used for digital outputs with DC process voltages if the mains of the cabinet is AC type. The process voltage must be grounded as described in this chapter.

Refer to the unit description for voltage tolerances and power rating.

**CAUTION**

The output voltage must be the safety extra-low voltage (SELV) type. The isolation between the mains and the process voltage must be reinforced and designed for at least overvoltage category III.

### 5.2.2.3 Process Voltage Supply from a Battery

The process power can be supplied directly from a battery. The battery must be grounded as described in this chapter.

Refer to the unit description for voltage tolerances and power ratings.

**CAUTION**

The output voltage must be the safety extra-low voltage (SELV) type. The isolation between the mains and the battery-charging voltage must be reinforced and designed for at least overvoltage category III.

#### 5.2.2.4  Screw Terminal Blocks

You can mount the screw terminal blocks for process signals and power supply side by side, individually at the top and bottom of the units. The process connectors are screw-type terminals (see figure below):

- 85 Screw-type terminals for process signals (two poles for most of the signals)
- 17 Screw-type terminals for power supply and ground.

## 5.3  Cabling and Process Signals

See the following sections for recommendations on choosing cables as well as rules for cable routing and grouping signals inside and outside the cabinet.

### 5.3.1  Cable Safety Requirements

The Advant Controller 55 internal processing circuits are grounded. The auxiliary voltage is SELV type (safety extra-low voltage). For safety reasons, any power or signal cable (non-SELV) connected to the system must have reinforced isolation to all other circuits.

### 5.3.2  Cable Recommendations

You can use unscreened cables for the power supplies and signals of DIs and DOs. Unscreened cables are also permissible for high-level AIs and AOs, providing the accuracy requirement is 12 bit.

Use special types of screened or coaxial cables (according to specification) for various types of buses.

Communication cables without a modem must always be routed separately from other cables.

Items of equipment with non-modem communication between them must be connected by a ground conductor.

Use screened pairs for AI/AOs with an accuracy requirement of >12-bit twisted. The screen must be grounded at the point where the signal circuit is grounded.

### 5.3.3  Signal Mixing in Multi-core Cables

With the exception of high-pulse signals, which must have individual pulse cables, signals of the same type can be conducted by the same multi-core cable.

## 5.3.4 Grounding

**NOTE**

All of the signal cables in a multi-core cable must be grounded at the same point.

Cable screens grounded at one point give effective protection against LF interference, whereas a cable screen grounded at both ends gives effective protection against HF interference at the expense of protection against LF interference. You must ground the cable screen at the point where the signal circuit(s) is (are) grounded. Ground the cable screen of pulse cables at both ends.

A double screen provides protection for both LF and HF interference. In this kind of cable, each pair has its own screen, so signals can be mixed (grounded at different points). The inner screens are always grounded at the same point as the signal circuits. The outer screens are grounded at both ends.

For more information, see *Interference-free electronics*.

## 5.3.5 Cable Routing

For EMC reasons, cable routing must comply with the following rules:

- Communication cables must approach the cable duct from the left and process cables must approach the cable duct from the right (see Figure 5-1).
- Communication cables not equipped with modems must be separated from process I/O cables, and from their own supply cables, by a distance of 100 mm, and from supply cables 600 V, by a distance of 300 mm.
- Process I/O cables, communication cables equipped with modems (isolated) and their own power supply cables must be separated from supply cables 600 V by a distance of 300 mm and by a distance of 100 mm from signal cables connected to a substation's (switchgear) environment.

### 5.3.5.1 Cable Routing Inside the Cabinet

For EMC reasons, cable routing must maintain the following spacing between different cables:

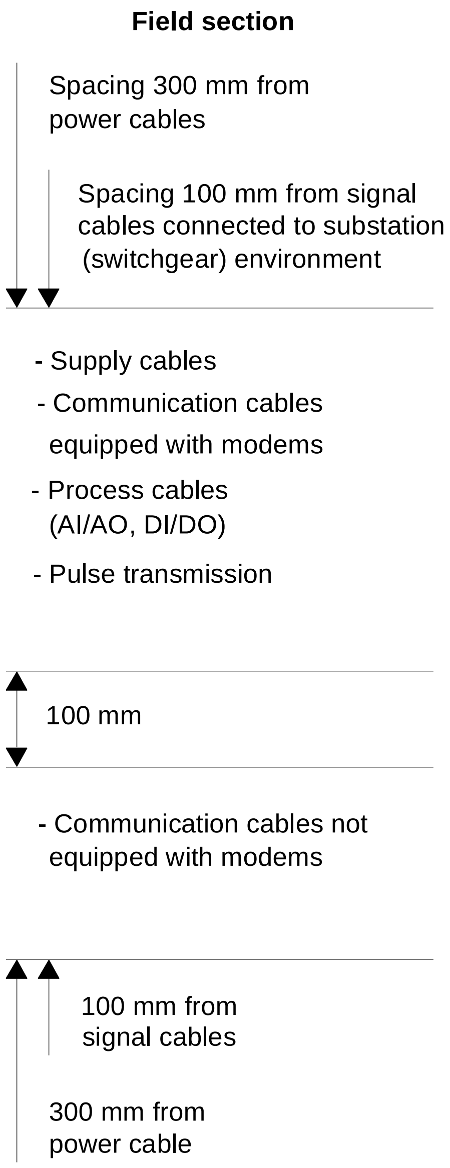

Field section
Spacing 300 mm from power cables
Spacing 100 mm from signal cables connected to substation (switchgear) environment
- Supply cables
- Communication cables equipped with modems
- Process cables (AI/AO, DI/DO)
- Pulse transmission
100 mm
- Communication cables not equipped with modems
100 mm from signal cables
300 mm from power cable

*Figure 5-6. Permissible Spacing between Different Types of Cables and Signals*

# Chapter 6 Commissioning

## 6.1 General

In this chapter, you find procedures for checking an Advant Controller 55's installation and for starting up an Advant Controller 55. The procedures and the order in which you should carry them out is as follows:

1. Check that the documentation is complete and that the specified test equipment is at hand (refer to Section 6.3, Equipment Required).
2. Inspect the installation visually, i.e., hardware modules, signal wiring, etc. (refer to Section 6.4, Visual Inspection).
3. Check that the process wiring is connected properly (refer to Section 6.5, Checking the Process Signal Wiring).
4. Check process voltage supply (refer to Section 6.6, Checking the Process Voltage).
5. Check the Advant Controller 55 power supply (refer to Section 6.7, Application of Voltage Supply).
6. Check I/O modules to and from the application program (refer to Section 6.9, Checking the Input/Output System).
7. Check the PC program (refer to Section 6.10, Functional Test and Correction of the PC Program).

## 6.2 Safety Regulations

**CAUTION**

**Read Section 5.1.1, Safety Regulations carefully before you start commissioning the system.**

## 6.3 Equipment Required

The following are minimum requirements:

- Standard hand tools, including a small screwdriver for the basic unit's START MODE selector.
- Universal instruments, e.g., a multimeter, a buzzer.
- Advant Station 100ES with options OPT1, OPT2 and OPT3.
- Spare units and fuses.

The following necessary product documentation should be available, for example:

- *Advant Controller 55 User’s Guide* (this document)
- *AMPL Configuration Advant Controller 100 Series Reference Manual*
- *Data Base Elements Advant Controller 55 Reference Manual*
- *PC Elements Advant Controller 55 Reference Manual*
- *RCOM Advant Controller 55 User's Guide*

The following specific project documentation should also be available, for example.:

- Hardware configuration
- Signal lists and connection diagrams
- Documentation of application programs.

## 6.4 Visual Inspection

When the system is installed, check its configuration against the information in the project documentation. Check that the equipment is undamaged and that the correct type of modules and cables, etc., are installed. Proceed as follows:

- Check that the types of units and their position are in accordance with the list of hardware.
- Check the setting of the START MODE selector switch on the basic unit.
- Check that the power supply cables and the serial interface cables are fitted correctly.

## 6.5 Checking the Process Signal Wiring

Before checking the process wiring, isolate the process from the control system by removing all the process screw terminal blocks from the units. Make sure that process power supplies are switched off.

Follow this procedure to check the signal wiring:

- Check the continuity of the external process wiring using a buzzer or suitable instrument.
- Check that all cable screens are properly grounded in accordance with the design drawings.
- Check that the wiring is routed in accordance with the design instructions.
- Without activating the control system, check that all transducers and actuators operate correctly. This requires connecting a voltage supply directly to the unit concerned and generating suitable input signals.

## 6.6 Checking the Process Voltage

Switch on process power supplies and check that the process voltage is available for the process signals.

- Using the multimeter, check that the correct output signals are obtained when process voltage is applied to the transducers and actuators.
- Leave the process circuits open when these checks are completed.

## 6.7 Application of Voltage Supply

### 6.7.1 Preliminary Checks

Perform the following checks before voltage is applied to the system:

- Check that all units, cables, etc., are located and connected correctly.
- Check that all process circuits are disconnected (open), that is, all screw terminal blocks for process signals are withdrawn.
- Check that all the process wiring is properly in the cable duct and that the cables are not subject to tension or pressure.
- Check that all cable screens are properly grounded.

### 6.7.2 Checking the Voltage Supply

Set the CPU to stop.

The station voltage should be switched on in stages. First, check the mains supply and then the station voltage supply. Proceed as follows:

- Switch on the mains supply (for example, circuit-breakers) and check that the LED (PW) lights (indicating correct input voltage) on the basic and expansion units.
- Now switch on the process and external transducer power supply and check that the LED (TP) lights (indicating correct transducer power supply voltage) on the basic and expansion units.
- Check that all the LEDs (FAULT) on the basic and expansion units are off. If not, trace the fault as instructed in Chapter 7, Fault Tracing.

The CPU starts. After some seconds, the RUN LEDs of the basic and expansion units light.

# 6.8 Connecting AS 100ES to AC 55 and Starting up

## 6.8.1 Starting Advant Controller 55

The START MODE selector behind the lid of the basic unit is a 16-position switch, of which three positions—1, 2 and 3—are used. The other positions are redundant and are not to be used. The START MODE selector controls the power-up and restart behavior of the CPU.

### CLEAR - Cold Start (Position 2)

Initialization starts from the beginning, and hardware and software are reset to an initial state. Application software is loaded from the internal PROM into the RAM.

The cold start is the reaction to a power failure, an error or if the INIT button is pushed.

You can define a Control Module Header executed once at initialization after a cold start. Set the C2 parameter of the CONTRM to 252 to do this.

Also, the PC elements below this CONTRM are executed only once after a cold start.

### AUTO - Warm Start (Position 3)

The system software attempts to restart the application program after an error or a power failure occurs. In that case, the integrity of the loaded application program is checked. If a re-start is possible, the system software continues executing the loaded application program where it was interrupted. This means that the timers (OSC-B, TON, . .) and closed loop controllers with time elements (PI, PDP, . .) continue their time measurement and keep their data during the warm start, just as they were before the warm start.

Also, data storing PC elements (SR, COUNT, REG . .) keep their data during a warm start.

If the loaded application program is corrupted or the INIT button is pushed, cold start is executed.

You can define a Control Module Header which is executed once at initialization after warm start. Set the C2 parameter of the CONTRM to 254 to do this.

Also, the PC elements below this CONTRM are executed only once after warm start.

### STOP (Position 1)

You can prevent the application program from starting if the start mode selector is in the stop position.

An error, which forces the CPU in AUTO or CLEAR mode to restart, leads to a system stop in STOP mode.

After power-up, or after you push the INIT button, the CPU is initialized, but the application is not loaded from internal PROM. The system software continues to operate to allow access to stored error messages by means of the AS 100ES.

In STOP position, it is not possible to load an application program.

The **INIT** button behind the lid of the basic unit reinitializes the CPU. If the INIT button is pushed, the CPU performs a cold start. If the START MODE selector is in position 2 (CLEAR) or 3 (AUTO), the application is loaded from the internal PROM. In position 1 (STOP) of the START MODE selector, the application is not loaded.

### 6.8.2 Connecting AS 100ES

For a detailed description of how to connect the Advant Station 100 Series Engineering Station (AS 100ES) to an Advant Controller 55 and how to start up and operate the AS 100ES, see:

- *Advant Station 100 Series Engineering Station AdvaBuild for Windows Environment User’s Guide.*

Advant Controller 55 has its own diagnostic test routines which run not only upon starting up the system, but also during normal operation. If an error is detected, an error message is generated and displayed on the AS 100ES screen. In case of a severe fault, the error status is also signaled by LEDs (FAULT) and presented on the diagnostic display on the basic unit.

For interpretations of these errors and their indications, see Chapter 7, Fault Tracing.

## 6.9 Checking the Input/Output System

### 6.9.1 General

The screw terminal blocks for process signals are now inserted and the channels are tested one by one. The output channels are tested from the PC program to the actuators in the process, and the input channels are tested from the transducers to the application software. In both cases, the operation of the hardware functions is observed on the signals on the modules, and the operation of the software functions is observed on the screen of the AS 100ES.

It may be necessary to simulate digital and analog input signals which are normally generated by the process. Suitable methods to do this are:

- Digital input signals

  Activate the input by applying a voltage, corresponding to the rated input signal voltage, as close as possible to the process transducer, in order to test as much of the process wiring as possible. You can also generate a test input signal by operating transducers manually, e.g., by actuating limit switches.

- Analog input signals

  Use a signal generator to generate analog signals. A simple test circuit to generate a voltage consists of a potentiometer connected across a suitable voltage source capable of producing a positive and a negative output. You need a current source capable of at least 20 mA to generate current signals. Analog test signals should also be injected as close as possible to the signal transducer to test as much as possible of the process wiring.

You can show on-line updating of input signal values on the AS 100ES in the function “Test.”

For a detailed description of how to operate the function “Test,” see the manuals *AMPL Configuration Advant Controller 100 Series Reference Manual* and *AdvaBuild for Windows Function Chart Builder User's Guide*.

The following must be fulfilled before you can set I/O parameters or display them on the AS 100ES:

1. Create an “AC 55 target” on the AS 100ES.
2. Create the DB part, i.e., the necessary DB elements for the basic and expansion units which are used. Analog and digital input and output channels are created automatically with the units.
3. Create a PC program.
4. Generate target code for the application program.
5. Connect the AS 100ES to the Advant Controller 55 and download the application program.
6. Start the application program on the Advant Controller 55.

## 6.9.2 Testing Input Signals

Test a digital input channel as shown in Figure 6-1. The procedure is very similar for analog signals (refer to Figure 6-2). Test digital and analog input channels as follows:

- Select a PC element terminal connected to the related DB element in the AS 100ES function “Test.”
- Select the menu item for display on the AS 100ES.
- Activate the signal input by activating the signal transducer or by simulating the signal.
- Check that the corresponding yellow input LED on the unit lights up (only digital modules). For analog inputs, measure the signal with a multimeter at the terminal of the process connector of the corresponding channel. Check that the change appears at the terminal “VALUE” of the DB element on the AS 100ES screen.
- Switch the test signal for a digital input to logical “0.” Check that the yellow input LED on the unit extinguishes and that the signal at the “VALUE” terminal goes to “0.”

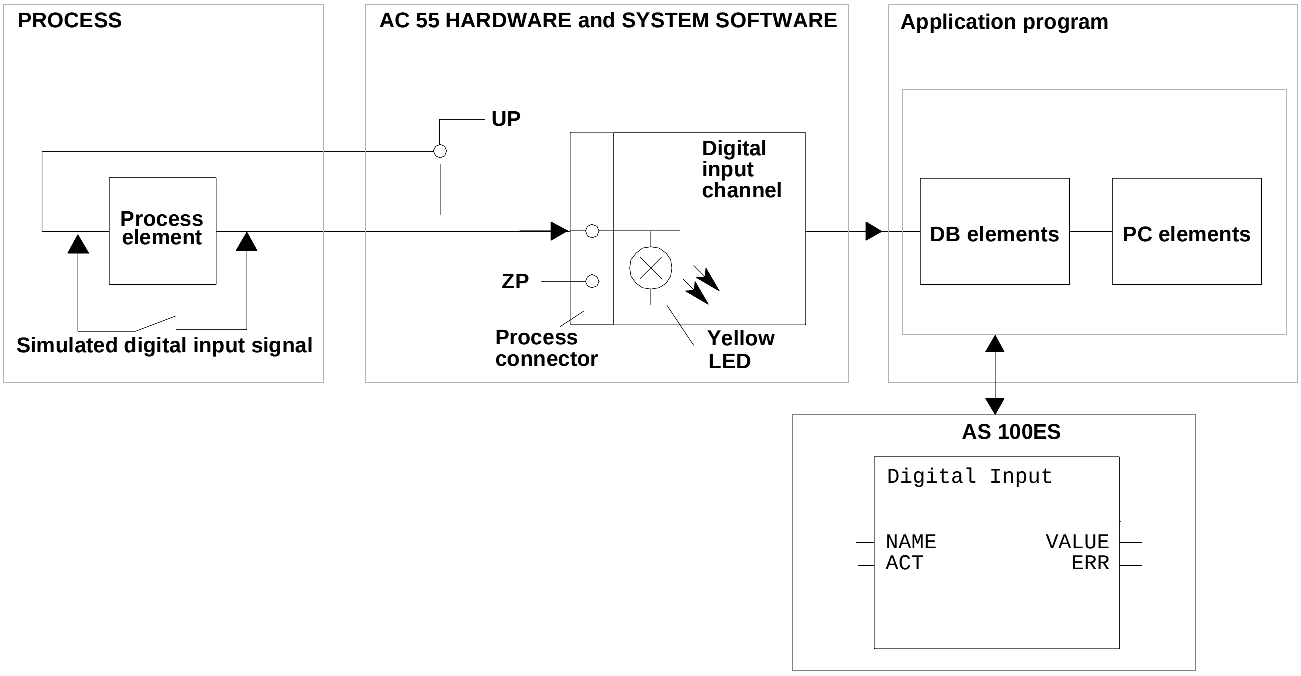


*Figure 6-1. Testing Digital Input Signals*

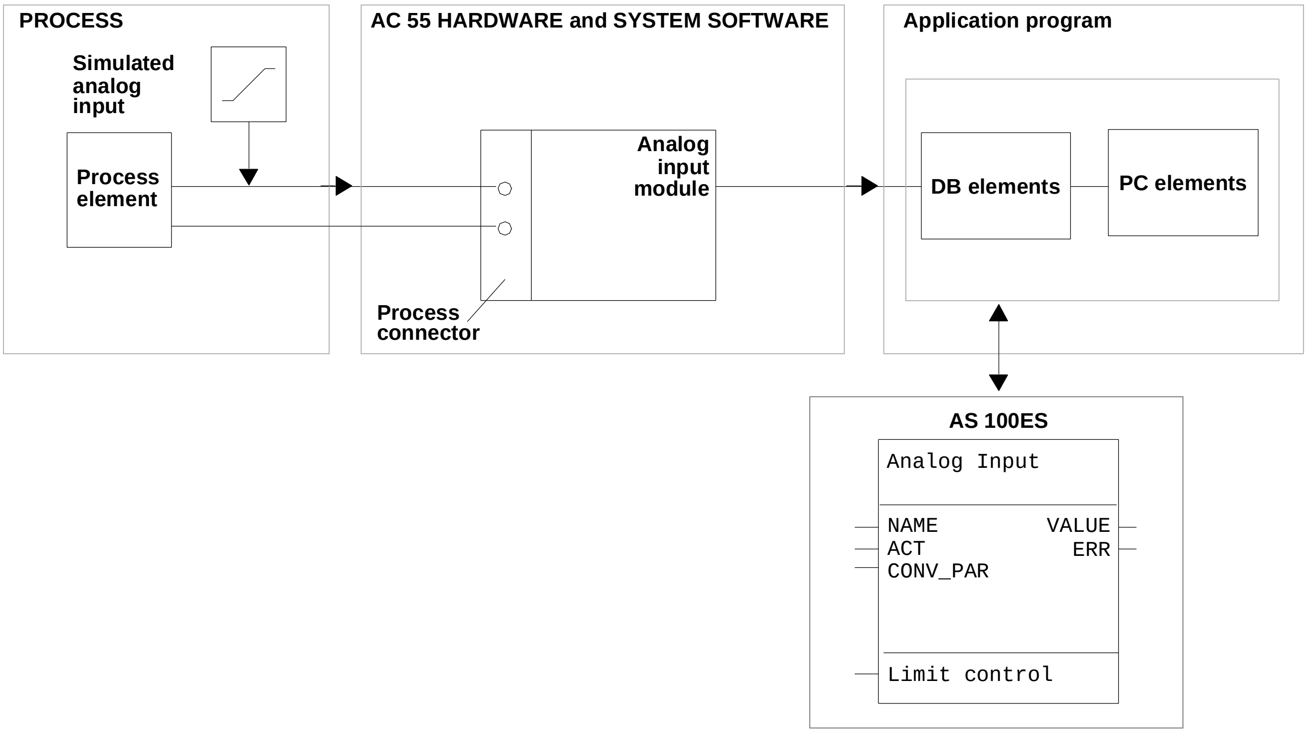


*Figure 6-2. Testing Analog Input Signals*

### 6.9.3 Testing Output Signals

Test a digital output channel as shown in Figure 6-3. The procedure is very similar for analog signals (refer to Figure 6-4). Test digital and analog output channels as follows:

- Select a PC element terminal connected to the related DB element in the AS 100ES function "Test."
- Select the menu item for forcing output signal values.
- Select the "VALUE" terminal on the DB element and enter the desired output value.
- Check that the corresponding yellow output LED on the unit lights up. For analog outputs, measure the signal with a multimeter at the terminal of the process connector or at the actuator.
- Reset the desired output value to a low value and check that the yellow output LED on the unit extinguishes and that the signal value changes.

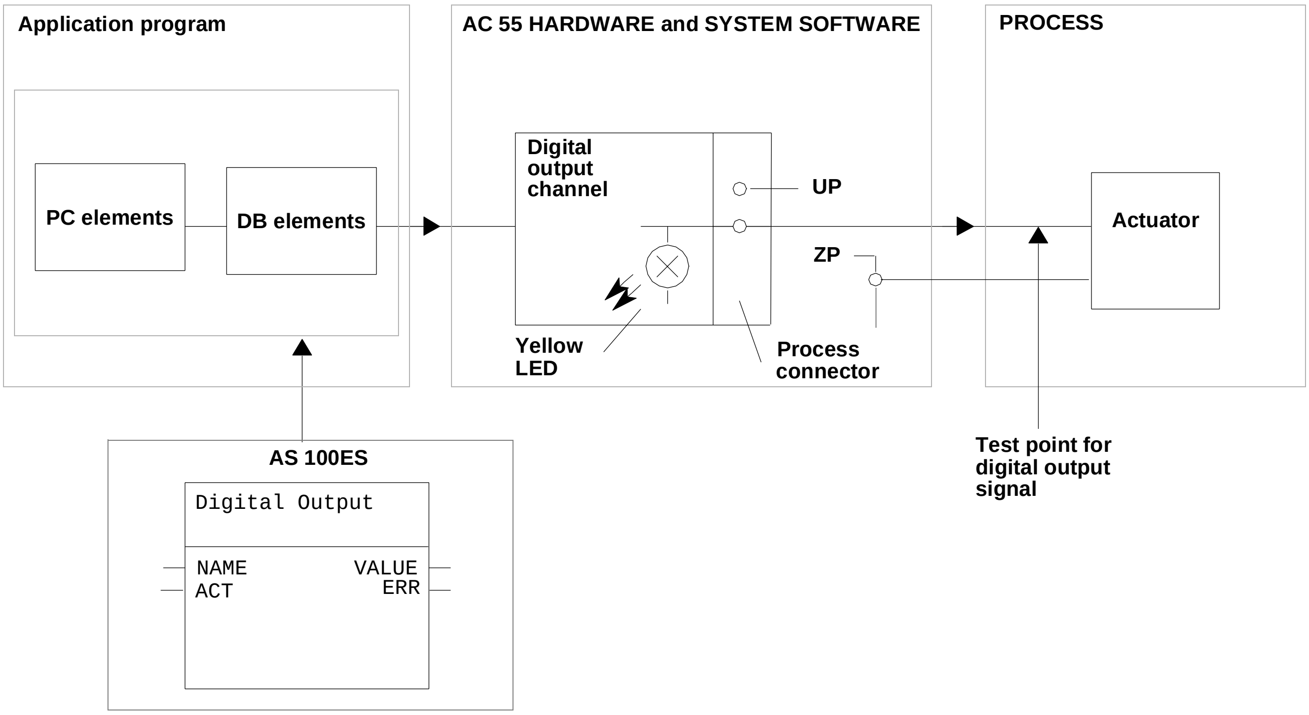


*Figure 6-3. Testing Digital Output Signals*

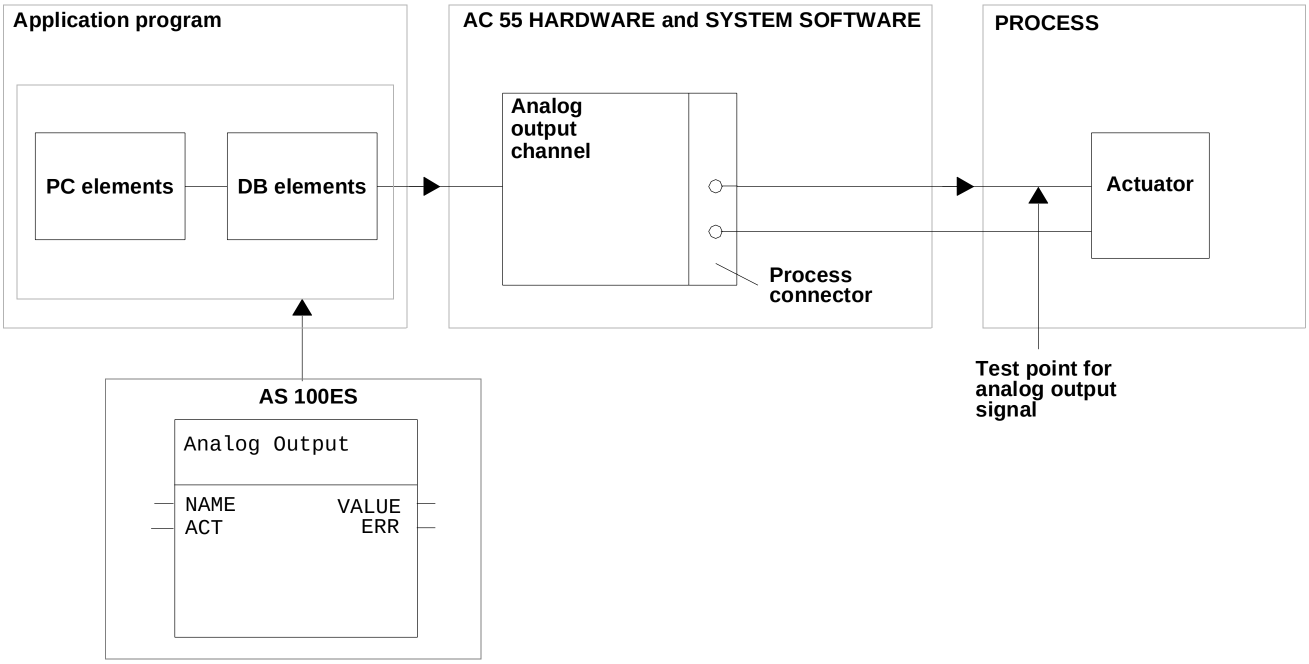


*Figure 6-4. Testing Analog Output Signals*

## 6.9.4 Downloading an Application Program

You can download an application program by connecting an Advant Station 100 Series Engineering Station (AS 100ES). An application program for an Advant Controller 55 system consists of a DB part and a PC program. The DB part and PC program cannot be downloaded separately.

The following must be fulfilled before you can load an application program from the AS 100ES:

1. Create an Advant Controller 55 target on the AS 100ES.
2. Create a DB part on the AS 100ES.
3. Create a PC program on the AS 100ES.
4. Generate target code for the application program of this target by selecting the related menu point item on the AS 100ES.
5. Connect the AS 100ES to the Advant Controller 55.

You can now download the application program. Do items 1 - 4 only once; do item 5 every time you download the application program.

## 6.10 Functional Test and Correction of the PC Program

Since the test requirements vary considerably from one installation to another, the design engineer is responsible for determining the limits within which the functional requirements apply and any other parameters which must be observed. The program is normally checked one execution unit at a time.

The testing and debugging facilities and the on-line modification of an application program are described in *AMPL Configuration Advant Controller 100 Series Reference Manual* and *AdvaBuild for Windows Function Chart Builder User's Guide*.

# Chapter 7 Fault Tracing

## 7.1 Introduction

### 7.1.1 Summary

The Advant Controller 55 has built-in supervision facilities for hardware units and programs. Diagnostic aids are available in different forms to rapidly locate the cause of equipment malfunction.

The fault is usually corrected by replacing the defective unit, which should be returned to the factory for repairs.

External faults in process wiring and transducers can also affect the operation of the Advant Controller 55. This type of fault is not discussed in this manual. See the manuals *AMPL Configuration Advant Controller 100 Series Reference Manual* and *AdvaBuild for Windows Function Chart Builder User's Guide* for a description of debugging PC programs.

This chapter, which covers fault tracing, is divided into two subchapters:

- Basic fault tracing
- Advanced fault tracing.

Simple tools such as LEDs on the units and a voltmeter are used for basic fault tracing. Advanced fault tracing requires an Advant Station 100 Series Engineering Station in addition to these tools.

### 7.1.2 Fault Detection and Indication

Both hardware units and system software in the Advant Controller 55 incorporate fault-detection facilities, which include the following.

LEDs on the units:

- A red LED F (FAULT) indicating a severe fault
- A green LED (e.g., RUN) indicating normal operation
- A yellow LED indicating an active signal.

Diagnostic display on the basic unit indicating:

- CPU status or program sequence
- Error codes in case of a severe fault with discontinuation of the program.

Error report on Advant Station 100 Series Engineering Station:

- Gives an error text about the probable cause of a malfunction.

## 7.1.3 Fault-Tracing Principles

Perform fault tracing in a systematic and logical manner. Before starting up a system which has not been in operation, always check that:

- The mains voltage is connected.
- All units are installed properly.
- All units are in the correct position.
- All connections are made correctly.

If these checks do not reveal the cause of a malfunction, continue with the procedure described in Section 7.1.4, Fault Classification, and then continue to Section 7.3, Advanced Fault Tracing. See Section 7.1.5, Start-up for instructions on how to restart a system after a fault has been corrected.

A fast and simple method of fault tracing is to reduce the system to a minimum by disconnecting all units except the basic unit. Then reinsert them, one by one, in their positions until the fault recurs.

**CAUTION**

**Units may not be connected or disconnected under voltage. Switch power off before you connect or disconnect a unit. New connected units are only recognized if you power-up or push the INIT button.**

## 7.1.4 Fault Classification

Faults can be divided into the following four groups.

- Faults in the power supply system:

  These faults are indicated on each of the units. If the green LED PW does not light, the fault is in the power supply and you must locate it according to the procedure in Figure 7-1 (4) for checking the power supply.

- Faults which do not stop the system:

  If the green LED RUN on the basic unit lights and no error code is displayed, the system is probably still operational and you must locate the fault as described in Section 7.2, Basic Fault Tracing.

- Faults which stop the system:

  If the red LED F (FAULT) on the basic unit lights up or the diagnostic display is displaying an error code to indicate that the system has stopped, refer to Figure 7-1 (5) on checking the central unit.

- Faults which give no indications:

  Refer to Section 7.3, Advanced Fault Tracing.

### 7.1.5 Start-up

You must restart the Advant Controller 55 after the system is forced to shut down by a severe fault.

You can do this using INIT, which results in a cold start with the START MODE selector in either the CLEAR (2) or the AUTO (3) position.

Attempt to diagnose the fault before restarting any system displaying error codes. Diagnosis can consist, for example, of noting error indications and error codes or starting up the system with the START MODE selector in the STOP (1) position and reading out the error report with the Advant Station 100 Series Engineering Station.

### 7.1.6 Safety

**CAUTION**

**Read Section 5.1.1, Safety Regulations before beginning to trace a fault.**

## 7.2 Basic Fault Tracing

### 7.2.1 Equipment

The signal LEDs provided on the Advant Controller 55 are normally sufficient for tracing faults. The following equipment, however, simplifies the work and should be available:

- Multimeter
- Standard hand tools
- System documentation according to
  Section 1.1, Documentation on Advant Controller 55
- Spare units and fuses.

### 7.2.2 Fault-Tracing Procedure

The following diagram shows the suggested fault-tracing procedure. The numbers indicate the sequence of the fault-tracing steps. You will find helpful information about each step on the following pages.

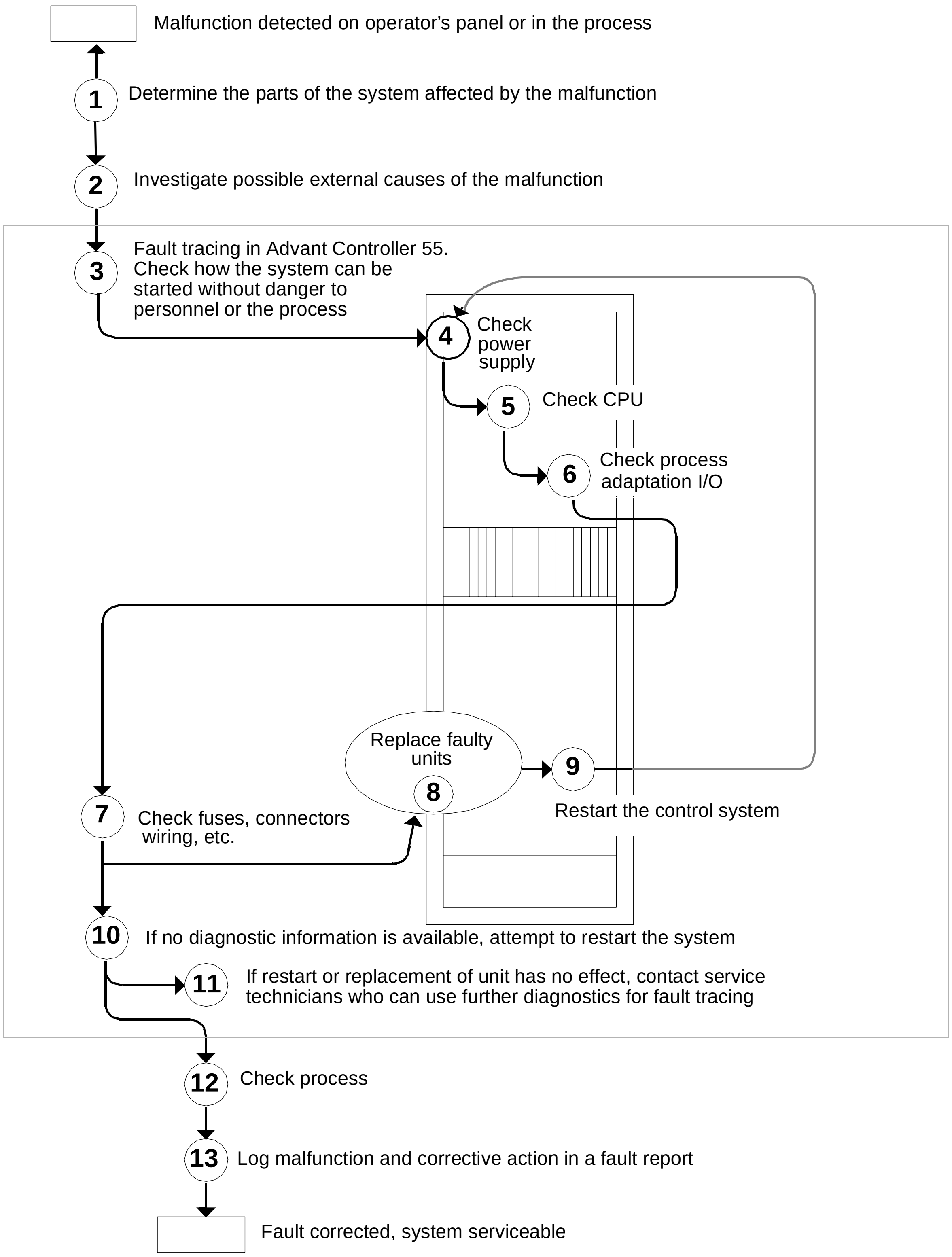

Malfunction detected on operator's panel or in the process
1
Determine the parts of the system affected by the malfunction
2
Investigate possible external causes of the malfunction
3
Fault tracing in Advant Controller 55. Check how the system can be started without danger to personnel or the process
4
Check power supply
5
Check CPU
6
Check process adaptation I/O
7
Check fuses, connectors wiring, etc.
Replace faulty units
8
9
Restart the control system
10
If no diagnostic information is available, attempt to restart the system
11
If restart or replacement of unit has no effect, contact service technicians who can use further diagnostics for fault tracing
12
Check process
13
Log malfunction and corrective action in a fault report
Fault corrected, system serviceable

*Figure 7-1. Fault-Tracing Procedure*

### (1) Locating the Cause of a Malfunction

Information displayed on the operator's panel and from the process can give some indication as to where a fault is located.

Experience shows that approximately 85 percent of all faults occur in the process itself, 10 percent in the application program and five percent in the control system hardware.

It is always advisable to follow this procedure to locate the cause of a malfunction to minimize downtime.

### (2) External Influences

In an electronic system which has been operating satisfactorily, most malfunctions have external causes. For this reason, it is important when you trace a fault to determine if any external factor such as incorrect handling of equipment, welding work, lightning and/or power failure has caused the malfunction.

### (3) Safety when Starting up and Shutting down

The Advant Controller 55 can only perform its control functions when in normal operation.

Voltage failure, a component fault or restarting manually usually affect the operation of the control system. Control system failure affects the process in different ways which vary in gravity:

- In a control system with a monitoring character, changes of process status are not registered, but there is no immediate danger to the process.
- Control of continuous processes demands a high degree of availability from the control system. Restarting the Advant Controller 55 in such situations can have very serious consequences.

It is, therefore, important to be aware of the local conditions and safety requirements when you start and stop the Advant Controller 55.

### (4) Checking the Power Supply

An Advant Controller 55 station can be supplied in one of two ways by using:

- Direct connection to the 115 V AC or 230 V AC mains.
- An external 24 V DC power source.
  In this case, the digital process voltage (24 V DC or 48 V DC) must also be supplied externally.

### Power Supply

As long as the green LED PW on every unit lights, the 5 V internal voltage is available. The 24 V unit voltage can be measured on the UD+ out, UA+ out and UD-, UA- terminals of the units. If supplied by 230 V AC or 115 V AC, the 24 V or 48 V digital process voltage can be measured on the UD+ and UD- terminals.

If the green LED TP lights up on every unit, there is no overload, no short circuit or interruption on the digital or analog process supply voltage.

If none of the four HW diagnostic LEDs is lighted, proceed as follows:

- Check the presence of input voltage (mains voltage, e.g., 230 V AC).
- If the input voltage is missing, check the mains fuses, circuit-breakers, etc.
- If the input voltage is not missing, check the fuses of the digital process power supply part of the unit (see Chapter 8, Maintenance and Repairs).

### (5) CPU Function

Check the following signals on the basic unit:

- The green LED RUN indicates that the CPU is operational.
- The red LED F (FAULT) indicates a severe fault and normally the basic unit must be replaced.
- The diagnostic display (see Chapter 4, Hardware Description) indicates the CPU operating mode or the error code in case of CPU halt:

| Display Code (LED) | Significance |
|---|---|
| P-<br>○<br>○<br>○<br>○<br>○<br>○<br>○<br>⊗ | Start-up. |
| P1<br>⊗<br>○<br>○<br>○<br>○<br>○<br>○<br>⊗ | Normal operation. |

| | |
|---|---|
| P3<br>⊗<br>⊗<br>○<br>○<br>○<br>○<br>○<br>⊗ | Stop after initialization. |
| P4<br>○<br>○<br>⊗<br>○<br>○<br>○<br>○<br>⊗ | CPU is not running an application. |
| P5<br>⊗<br>○<br>⊗<br>○<br>○<br>○<br>○<br>⊗ | Loading application program from PROM. |
| P6<br>○<br>⊗<br>⊗<br>○<br>○<br>○<br>○<br>⊗ | MasterAid connected. |
| PL<br>⊗<br>⊗<br>⊗<br>⊗<br>⊗<br>⊗<br>⊗<br>⊗ | Waiting for download of system software or updating (loading of option) is just in progress. |
| 05..7F<br>⊗<br>⊗<br>⊗<br>⊗<br>⊗<br>⊗<br>⊗<br>○ | Error Code leading to a system halt:<br>If the lowest LED is off, the error code is indicated by the upper seven LEDs.<br>For the error codes, see Table 7-1. |

### (6) Checking the Process I/Os

Check the LEDs F (FAULT) and RUN (refer to Chapter 3, System Description).

- RUN = unit in the active (RUN) state.
- F (FAULT) = severe fault detected by the unit's self-testing facility.

Action to take in case of a FAULT signal:

- Replace the unit with the LED FAULT lit. The LED FAULT indicates a severe fault which can normally be repaired only in the factory.

Action to take when there is no RUN signal:

- Check if the unit is activated in the corresponding DB element (IMPL=1). This requires an Advant Station 100 Series Engineering Station.
- Try to get more information via error report (requires an Advant Station 100 Series ES).

### Status of I/O Signals

The status of the digital signals (DI, DO) is indicated by a yellow LED for each signal connected to the process.

- Digital input signals: The signal status LED will light in the case of input signal 1, if the system is running. An application program is not necessary for the digital input LED to light.
- Digital output signals: The signal status LED is only lighted if an application is executed which outputs 1 to the digital output.
- Check the process voltage supply and fuses for process signals. Fuses or circuit-breakers are the most frequent cause of missing process signals.
- Check the signal levels at the terminals of the process connector.

### (7) Checking the Installation

Open circuits, short circuits and loose connections can occur. Therefore, check as necessary:

- External fuses
- Screwed terminal blocks at the units
- Wiring, screwed terminals
- Mechanical installation.

### (8) Replacement of Defective Units

Units may only be replaced if power is switched off.

Do the following when replacing units:

- Follow the requirements of Section 6.2, Safety Regulations
- Follow the instructions of Section 8.2, Unit Replacement
- Check that the new unit is of the correct type
- Transfer any labels indicating the position, etc., from the original to the new unit
- Note any symptoms observed and other useful information and attach this information to the unit returned for repair.

### (9) Restart the Control System

After replacement of the defective units, restart the control system.

### (10) System Restart

If no diagnostic information is available, attempt to restart the system. To restart the system, switch the power supply on, which results in a cold start with the START MODE selector in the CLEAR (2) position.

### (11) Fault Tracing by Interpretation of Fault Symptoms

Refer to Section 7.3, Advanced Fault Tracing.

If the diagnostic information presented is insufficient, contact a suitable service workshop to assist you in interpreting the symptoms, or attempt to obtain more details with the aid of the usual service equipment.

### (12) Checking Process Functions

- Compare with the original performance to check that the correct action has been taken.
- Check that the original operating parameters, etc., have not been changed by the fault-tracing action.
- Use any checklist which may be available on site.

### (13) Log Symptoms and Corrective Action or Repairs in a Fault Report

Information regarding previous malfunctioning can be of great assistance for subsequent maintenance of the equipment. Keep a record of all faults and corrective action taken.

## 7.3 Advanced Fault Tracing

Advanced fault tracing is for the detection of errors in application and system software, and when the system does not operate at all, with the help of:

- LEDs on the units
- Diagnostic display on the CPU
- Error reports using the Advant Station 100 Series ES
- Fault tracing by interpretation of fault symptoms.

You will need the Advant Station 100 Series ES in addition to the equipment necessary for basic fault tracing.

## 7.3.1 Faults which Stop the System

Faults which completely stop the system can be caused by a defective basic unit.

In the case of a severe fault, which stops the CPU, a two-digit error code is presented on the basic unit's diagnostic display (the lower right-hand group of eight LEDs). Should the LED F (FAULT) light, the CPU itself is probably defective.

Fatal errors are stored in the CPU and can be read by the Advant Station 100 Series Engineering Station using the error report function (see Section 7.3.2, Faults Shown by Error Report).

The following table defines all error codes, their names and their significance. It also gives hints on what action you should take.

*Table 7-1. Halt Error Codes on Display*

| Error Code (LED) | Significance | Corrective Action |
|---|---|---|
| 05<br>⊗<br>○<br>⊗<br>○<br>○<br>○<br>○<br>○ | Bus error - memory.<br>The processor tried to access a nonexistent memory location. This indicates a serious system software error or defective hardware. | Restart the system by pressing the INIT push button with the START MODE selector in either the CLEAR or AUTO position.<br>Replace the basic unit. |
| 09<br>⊗<br>○<br>○<br>⊗<br>○<br>○<br>○<br>○ | Stall alarm.<br>This is a software problem and indicates that the CPU is not working correctly. It is probably caused by a CPU overload. | Restart the system by pressing the INIT push button with the START MODE selector in the STOP position.<br>Extend the cycle times of execution units in the PC program or remove one or more execution units, e.g., control units, and load and deblock the application again. |
| 0A<br>○<br>⊗<br>○<br>⊗<br>○<br>○<br>○<br>○ | Memory test error.<br>The error code appears during the RAM test, which is performed during system initialization. | Replace the basic unit. |
| 0C<br>○<br>○<br>⊗<br>⊗<br>○<br>○<br>○<br>○ | Instruction set fault. | Replace the basic unit. |

*Table 7-1. Halt Error Codes on Display (Continued)*

| **Error Code (LED)** | **Significance** | **Corrective Action** |
|---|---|---|
| 0D<br>☒○☒☒<br>○○○○ | Interval timer test failed. | Replace the basic unit. |
| 0F<br>☒☒☒☒<br>○○○○ | Bus error test failed.<br>This is a hardware problem and indicates a CPU internal bus error. | Replace the basic unit. |
| 22<br>○☒○○<br>○☒○○ | START MODE selector in the STOP position.<br>The START MODE selector on the CPU was in STOP position when the system attempted to start. | Restart the system by pressing the INIT push button with the START MODE selector in either the CLEAR or AUTO position. |
| 27<br>☒☒☒○<br>○☒○○ | Insufficient memory.<br>The CPU could not start the application due to lack of memory. | Restart the system by pressing the INIT push button with the START MODE selector in STOP position. Then remove all loaded but unused options which may consume memory by loading BASE software. Enable only necessary options and restart the system by pressing the INIT push button with the START MODE selector in CLEAR position. |
| 42<br>○☒○○<br>○○☒○ | Overload.<br>The CPU was not able to run the specified control unit. The control unit could not be completed within the specified cycle time and was aborted. | Restart the system by pressing the INIT push button with the START MODE selector in STOP position. Then reduce the load by extending the cycle times, for example, of control units in the PC program or remove one or more execution units, e.g., control units.<br>Load and deblock the application again. |
| 43<br>☒☒○○<br>○○☒○ | User PROM error.<br>This indicates that the memory used for storing the application program could be defective. | Restart the system by pressing the INIT push button with the START MODE selector in STOP position. Then reload the application program and try to save it again in PROM.<br>Replace the basic unit. |

*Table 7-1. Halt Error Codes on Display (Continued)*

| **Error Code (LED)** | **Significance** | **Corrective Action** |
|---|---|---|
| 44<br>○<br>○<br>⊗<br>○<br><br>○<br>○<br>⊗<br>○ | System PROM error.<br>This indicates that the memory used for storing the system software could be defective. | Reload the system software and try again.<br>Replace the basic unit. |
| 45<br>⊗<br>○<br>⊗<br>○<br><br>○<br>○<br>⊗<br>○ | Stall timer defect.<br>This is a hardware problem. | Replace the basic unit. |
| 46<br>○<br>⊗<br>⊗<br>○<br><br>○<br>○<br>⊗<br>○ | UART defect.<br>This is a hardware problem. | Replace the basic unit. |
| 47<br>⊗<br>⊗<br>⊗<br>○<br><br>○<br>○<br>⊗<br>○ | RAM check failed.<br>This is a memory problem and indicates inconsistencies of the data stored in the RAM. | Restart the system by pressing the INIT push button with the START MODE selector in either the CLEAR or AUTO position.<br>Replace the basic unit. |
| 49<br>⊗<br>○<br>○<br>⊗<br><br>○<br>○<br>⊗<br>○ | Internal error.<br>Indicates an unexpected state, usually due to a system error. | Restart the system by pressing the INIT push button with the START MODE selector in either the CLEAR or AUTO position.<br>Reload the application program and try again.<br>Replace the basic unit. |
| 4A<br>○<br>⊗<br>○<br>⊗<br><br>○<br>○<br>⊗<br>⊗ | Power failure.<br>Indicates that the AC 55 was switched off or that there was a power failure (complete basic station or extension backplane of basic station). | Check the power supply to the extension backplane of the basic station. |

*Table 7-1. Halt Error Codes on Display (Continued)*

| Error Code (LED) | Significance | Corrective Action |
|---|---|---|
| 4C<br>○<br>○<br>○<br>○<br><br>○<br>○<br>⊗<br>○ | Address error.<br>This is a software problem and indicates that the CPU is not working correctly. | Restart the system by pressing the INIT push button with the START MODE selector in either the CLEAR or AUTO position.<br>Reload the system software.<br>Replace the basic unit. |
| 4D<br>⊗<br>○<br>⊗<br>⊗<br><br>○<br>○<br>⊗<br>○ | Processor generated exception.<br>This is a software problem and indicates that the CPU is not working correctly. | Restart the system by pressing the INIT push button with the START MODE selector in either the CLEAR or AUTO position.<br>Reload the system software.<br>Replace the basic unit. |
| 51<br>⊗<br>○<br>○<br>○<br><br>⊗<br>○<br>⊗<br>○ | Not available function block.<br>Indicates that a function block (i.e., PC element or DB element) has been called which the current system software does not recognize. | Load the correct system software or reduce the application program to match current system software. |
| 55<br>⊗<br>○<br>⊗<br>○<br><br>⊗<br>○<br>⊗<br>○ | BOOT PROM error.<br>This is a hardware error. | Replace the basic unit. |
| 5D<br>⊗<br>○<br>⊗<br>⊗<br><br>⊗<br>○<br>⊗<br>○ | Application in PROM generated for another system software release.<br>This may occur after loading of a new system software. | Restart the system by pressing the INIT push button with the START MODE selector in STOP position. Then generate new target code with a matching release of the AS 100 ES, download to, and save it in, PROM. |
| 63<br>⊗<br>⊗<br>○<br>○<br><br>○<br>⊗<br>⊗<br>○ | Missing option.<br>Indicates that the application in PROM needs an option that is not part of the system software (probably due to download of new BASE system software). | Restart the system by pressing the INIT push button with the START MODE selector in the STOP position. Then install the missing option and restart the system with the START MODE selector in either the CLEAR or AUTO position. |

## 7.3.2 Faults Shown by Error Report

You can obtain an error report from the system using the Advant Station 100 Series Engineering Station, see *AMPL Configuration Advant Controller 100 Series Reference Manual*. The error report indicates whether the system's diagnostic function has detected any fault or otherwise abnormal condition.

Apart from messages of non-fatal errors, such as I/O errors, the error report also includes messages for errors which lead to a system stop.

For tracing unit or system errors, you can delete older error entries when leaving the error report. Errors that are permanently present in the system are inserted again with an updated time stamp.

## 7.3.3 Fault Tracing by Interpretation of Fault Symptoms

Follow this procedure to locate unit faults, which do not activate the built-in supervision system, and faults in the signal connections and the wiring.

This type of fault tracing assumes knowledge of the process functions and the availability of circuit diagrams and other relevant documents. Follow this procedure:

- Study the fault symptoms and determine the inputs and outputs affected.
- For example, the fault is on a digital input. The signal status LED on the unit lights, but the value in the data base element is not updated. In the case of analog signals, first check that the signal is activated in the data base element.
- Determine whether the fault is in the process equipment or wiring, or in the Advant Controller 55. Do this by measuring the input/output signals at the process screw terminal blocks.
- If the fault is found to be in the Advant Controller 55 equipment, attempt to track it in from the screw terminal block to the input signal data base element. If the signal is an output signal, the fault is traced in the opposite direction. It should be possible to locate the fault following this procedure.

# Chapter 8  Maintenance and Repairs

## 8.1  Preventive Maintenance

This chapter describes routine maintenance procedures which you should be carry out regularly. Read Section 5.1.1, Safety Regulations before beginning work.

## 8.1.1  Visual Inspection

Inspect the Advant Controller 55 system at intervals which depend on environmental factors such as vibration, air pollution and temperature.

### 8.1.1.1  Safety

Check that all screwed connections are properly tightened. Ensure that wiring, modules and other electrical components are undamaged. Pay particular attention to signs of overheating, damaged isolation or wear.

### 8.1.1.2  Cleanliness

Remove dust, etc., from the cabinet with compressed air or a vacuum cleaner. Use a lint-free cloth dampened with methylated spirits to remove stubborn dirt.

### 8.1.1.3  Air Filter

If an external air filter is included in the equipment, wash it in warm water with a mild detergent at intervals determined by the prevailing environmental conditions. Replace the filter after it has been washed three times. The new filter must be an approved spare.

### 8.1.1.4  Forced Cooling

If an external fan is fitted, check its operation also.

### 8.1.1.5 Changing Fuses

The basic unit and the expansion unit each have four fuses: two for the 230/115 V AC power supply, one for the 24 V DC power supply and one for the digital input process power supply.

If the green LED PW is not set when the supply voltage is connected, the power supply fuses have probably blown. This in turn indicates an internal fault in the unit, and it should be submitted to an ABB representative for repair.

If the green LED TP is not set, the fuse for the digital input process power supply has probably blown. Replace it in the following way:

1. Unscrew the top of the fuse holder counterclockwise (according to the arrow in the figure below).
2. Lift the top, replace the fuse and remount the top clockwise.

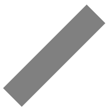


*Figure 8-1. Changing a Fuse*

## 8.2 Unit Replacement

The system software in the Advant Controller 55 automatically checks that all units are operating correctly. In the event of a defective or missing unit (e.g., during replacement), the unit and associated signals are flagged at the "ERR" terminal of the data base elements. The signal value (VALUE) is not updated as long as the error persists. Missing units are indicated by the error report via AS 100ES.

If the system starts, it runs a self-testing routine following power-up and during operation. Providing no serious defect is detected, the red LED (FAULT) on the unit extinguishes. The system software checks that:

- The unit is of the correct type
- The unit is not defective
- The expansion cable is in place.

If all these points are in order, the green LED (RUN) lights up, the error flag on the data base element is reset and the system switches to the operating mode.

If these points are not in order (e.g., the red LED (FAULT) lights) the unit should be replaced. (See Section 8.2.1, Procedure to Replace a Unit.)

Units may not be replaced, connected or disconnected under voltage.

- Switch power for all units off before you disconnect a unit's protective ground or the expansion cable.
- After replacing a unit, connect the protective ground first and then connect the expansion cable before you switch the power on.
- Note that a new connected expansion unit is not recognized by the CPU until a cold start or warm start is performed.

**WARNING**

Never replace a unit in a running system because the units may be destroyed and the process equipment may be damaged if critical signals are not updated.

### 8.2.1 Procedure to Replace a Unit

**Follow this procedure to replace a faulty or suspect unit**:

- Read Section 5.1.1.1, Personnel Safety.
- Switch power off for all units.
- Remove the lid of the unit (see Figure 8-2 below).
- Remove the paper strip (with the signal names) on the front of the unit to use again with the new unit. Remove the supply and process screw terminal blocks.

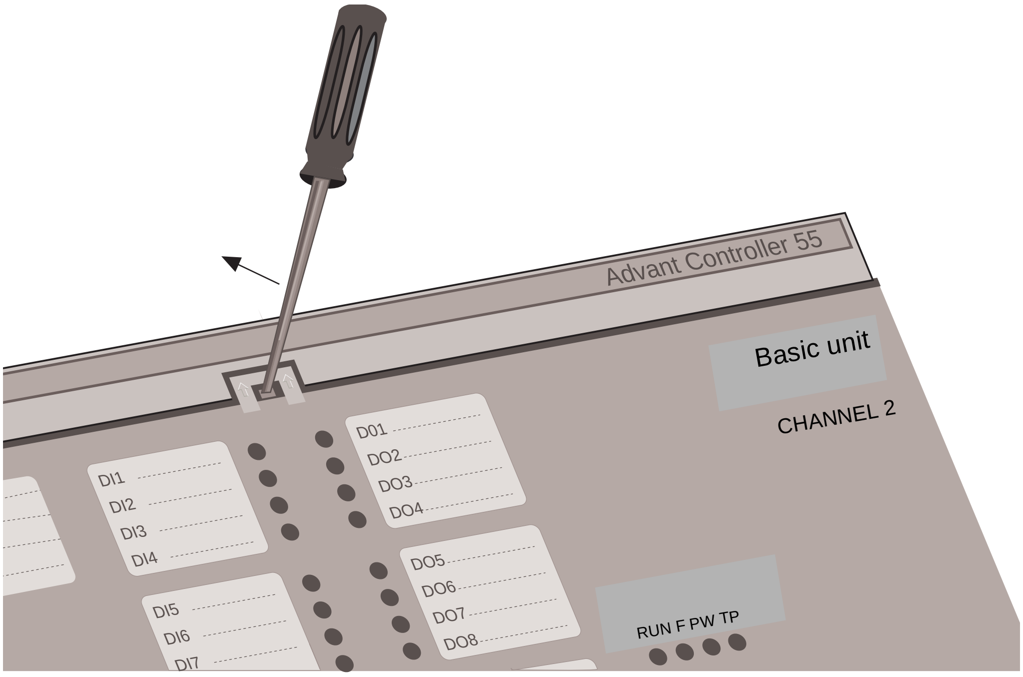


*Figure 8-2. Remove the Lid of an Advant Controller 55 Unit*

- Remove the expansion unit cable connector (see Figure 8-3). The connector is located at the same place in the basic unit and expansion units.
- Remove the protective ground.
- Release the screws fixing the unit and withdraw the unit.

*Figure 8-3. Advant Controller 55 Basic Unit with Expansion Unit Connector (Lid removed)*

- Check that the new unit is the same type as the old unit.
- Insert the new unit. Ensure that it is fully in place. Tighten the unit fixing screws.
- Reconnect the protective ground.
- Reconnect the expansion unit cable.
- Insert the process and supply screw terminal blocks.
- Exchange the paper strips and replace the lid of the unit.
- Switch supply voltage on and check that all FAULT LEDs are off and that the RUN LEDs light up.
- If a new basic unit is inserted, the application must be loaded again. This requires an Advant Station 100 Series Engineering Station and detailed knowledge about how to load and start an application. Please refer to the *AMPL Configuration Advant Controller 100 Series Reference Manual* for details.

## 8.2.2 Calibration of Analog Inputs and Outputs

During the course of manufacture, all measurement and output ranges of analog I/O modules are calibrated by factory software at an ambient temperature of 25°C. Normally, the modules need no further calibration.

Should you find, however, that the accuracy is outside the specified limits (e.g., due to component failure), contact your local ABB representative for repair. You cannot recalibrate these units yourself.

The analog modules are designed in such a way that component aging has little effect on specified accuracy. This is the result of the use of high-quality, low-drift components. For example, the analog circuits do not include any potentiometers (which are often the cause of drift problems).

*Table 8-1. I/O Channels, Accuracy and Calibration*

| Type of Channel | Accuracy | Potentiometers | SW-calibration |
|---|---|---|---|
| Analog inputs | 0.25 % | No | Yes (factory) |
| Analog outputs | 0.25 % | No | Yes (factory) |

# Chapter 9 Memory Requirements

## 9.1 General

The Advant Controller 55 basic units CT 481 and CT 482 provide 224 kBytes of PROM for storage of application code and configuration data. During runtime of the application, the code and configuration data is copied into the RAM of the CPU module. Additional RAM is required for the necessary data areas for intermediate data storage.

The amount of free RAM is dependent on the number and type of options actually loaded into the system. Typically, the free RAM size is approximately 300 kBytes.

You can determine the exact free memory size each time via the "Status Report" menu.

During the execution of an "on-line change", extra RAM is needed. If the memory is already consumed by loading a big application, you are alerted by the engineering stations with the warning, "Not enough memory on target available."

### Calculation of memory needs in Advant Controller 55

**NOTE**

The following calculations are difficult and time-consuming; however, they are necessary to get an accurate result. For a quick but rough overview, use the "5 steps approach" below.

Once the application is prepared and downloaded to the target, you can obtain an exact report about free memory resources on the target via the "Status Report" menu.

**The following calculation must be made for the PCPGM once per application.!**

| formula to use | calculated memory size | | rounded result | comments |
|---|---|---|---|---|
| constant | 2000 bytes | | | |
| M = m1 + m2 +.. $m_N$(1) | | | | N=number of CONTRMs "connection to other CONTRMs" below |
| sum -> | | -> | | RAM only |

(1) See calculation for **m** at the table following later, "*Connections to other CONTRMs* ."

**The following calculation must be made for every DB element!.**

| calculation formula to use(1) | calculated memory size | | rounded result | comments |
|---|---|---|---|---|
| **N** | | | | |
| sum -> | | -> | | RAM only |
| | | | | |
| constant | 130 bytes | | | |
| **R** | | | | |
| sum -> | | -> | | PROM and RAM |
| | | | | |
| constant | 130 bytes | | | |
| **O** | | | | |
| sum -> | | -> | | PROM and RAM |
| | | | | |
| **P** | | | | |
| sum -> | | -> | | RAM only |
| | | | | |
| **Q** | | | | |
| sum -> | | -> | | RAM only |
| | | | | |
| const | 6 bytes | | | |
| **S** | | | | |
| sum -> | | -> | | RAM only |

(1) See table following later, "*DB element s* ."

Round up the results in the framed fields to the next 256 Bytes boarder and add to the final result.

**The following calculations must be repeated for each of the CONTRMs the application consists of.**

| formula to use | calculated memory size | | rounded result | comments |
|---|---|---|---|---|
| const | 130 bytes | | | |
| + **A** (1) | | | | |
| + **C** (2) | | | | |
| + **D** (3) | | | | |
| + **G** (4) | | | | |
| + **I** (5) | | | | |
| + **K** (6) | | | | |
| sum -> | | -> | | RAM and PROM |
| | | | | |
| const | 264 bytes | | | |
| + **B** (7) | | | | |
| + **E** (8) | | | | |
| + **F** (9) | | | | |
| + **H** (10) | | | | |
| + **J** (11) | | | | |
| + **L** (12) | | | | |
| sum -> | | -> | | RAM and PROM |
| | | | | |

(1) See the table following later, "*PC elements.* "
(2) See the table following later, "*Connections to I/O .*"
(3) See the table following later, "*Connections to I/O .*"
(4) See the table following later, "*Connections to Common Data .*"
(5) See the table following later, "*Connections to Constants .*"
(6) See the table following later, "*Connections to other CONTRMs.* "
(7) See the table following later, "*PC elements .*"
(8) See the table following later, "*Connections to I/O .*"
(9) See the table following later, "*Connections to I/O.* "
(10) See the table following later, "*Connections to Common Data .*"
(11) See the table following later, "*Connections to Constants .*"
(12) See the table following later, "*Connections to other CONTRMs .*"

Round up the result in the framed fields to the next 256 Bytes boarder and add to the final result which determines the required RAM space.

Only those parts explicitly marked in the comments contribute to the required PROM space. You can use the results from “calculated memory size” (not rounded up) plus 1500 bytes to find the total amount of required PROM.

The following sections give formulas and references for the detailed calculation of all memory-consuming parts of the application. Use the results to fill in the sheets above accordingly.

| **Component** | ***PC elements*** |
|---|---|
| A | sum of “PC statement (byte)” according to “**PC Elements**“ manual, Chapter 6 |
| B | sum of “Local Data Area (byte)” according to “**PC Elements**“ manual, Chapter 6 |

| **Component** | ***Connections to I/O*** |
|---|---|
| C | sum of connections to “module DB elements” (byte) according to “**Data Base Elements**” manual Memory req. (Get/Put) (bytes) |
| E | sum of “module DB elements * 2 bytes |
| D | $d_1 + d_2 + d_3 + \dots d_N$<br>$d_1..d_N$ sum of “channel DB elements” (bytes) according to “**Data Base Elements**” manual Memory requirements (Get/Put) bytes. N= number of boards connected to this CONTRM |
| F | sum of input channel DB elements (connected terminals only)<br>2 bytes for each B,I input channel<br>4 bytes for each IL,R input channel |

| **Component** | ***Connections to Common Data*** |
|---|---|
| G | 4 bytes for each DAT, PARDAT<br>6 + 6 * N bytes for each DAT(B)<br>N = number of connected terminals of this DAT |
| H | 2 bytes for each B,I input<br>4 bytes for each IL,R input |

| Component | ***Connections to Constants*** |
|---|---|
| I | 4 bytes for each B,I<br>6 bytes for each IL,R,T,TR<br>6 +2 * N bytes for each A (N=length of array |
| J | 2 bytes for each B,I<br>4 bytes for each I,R,TR<br>N+3 bytes for each A (N=length of array) |

| Component | ***Connections to other CONTRMs*** |
|---|---|
| K | 4 bytes for each B,I,IL,R,T,TR<br>6 bytes for each A,G |
| L | for all **inputs** from other CONTRMs<br>2 bytes for each B,I<br>4 bytes for each IL,R,TR<br>N+3 bytes for each A<br>2*N for **G** of type B,I<br>4*N for **G** of type IL,R,T,TR |
| m | for all **outputs** to other CONTRMs<br>2 bytes for each B,I<br>4 bytes for each IL,R,TR<br>N+3 bytes for each A<br>2*N for **G** of type B,I<br>4*N for **G** of type IL,R,T,TR |

| Component | ***DB elements*** |
|---|---|
| N | sum of "Common Data" according to "**Data Base Elements**" manual Memory requirements |
| O | sum of "Common Data Description" according to "**Data Base Elements**" manual Memory requirements |
| P | sum of "Common data extended" according to "**Data Base Elements**" manual Memory requirements |
| Q | sum of "Common Data Event Queue" according to "**Data Base Elements**" manual Memory requirements |
| R | sum of "Configuration Data" according to **"DB elements"** manual Memory requirements |
| S | sum of "Common Configuration addresses" according to **"DB elements"** manual Memory requirements |

Remarks

For each of the CONTRMs the application program consists of, the calculations must be made.

The calculations for SEQ are made in exactly the same way as those for the CONTRM.

The calculations for MASTER and SLAVE must be made as follows:

1. calculate separately the memory needs for the MASTER and all subordinated SLAVEs according to the rules given for the CONTRM.
2. The resulting memory need is the sum of all calculated parts.

A method for a rough estimate of the Advant Controller 55 memory needs follows.

**NOTE**

The result is only a rough estimate which can be made in a reasonable amount of time and before your real application programming is ready.

Step 1: Calculate the required "PC element statement" size and "local data" size for your CONTRMs according to the formulas and data given in the "PC elements" manual for Advant Controller 55

Step 2: Calculate the memory needs for the connections in your application. For each CONTRM, the signals into the CONTRM must be respected.
Use 2 bytes for each B or I signal, use 4 bytes for each IL,R,T or TR signal.

Step 3: Calculate the required amount of "configuration data," "common data description," "common data," "common data extended" and "common data event queue" according to the formulas and data given in the "DB elements" manual for Advant Controller 55.

Step 4: Reserve 10 bytes extra for each signal into or from the CONTRM.

Step 5: Calculate the total memory from the sum of all step 1 to step 4 partial results.

# Chapter 10 Performance

The performance of an Advant Controller 55 depends on the CPU load of the application program. The CPU load of an application program is determined by

- the CPU load from all executabele units (PCPGM, CONTRM, MASTER, SEQ)
- the CPU load from MVI data block communication (MVB)
- the CPU load from event detection

## 10.1 CPU Load from Executable Units

The CPU load from executable units (PCPGM, CONTRM, MASTER, SEQ) is determined by the execution time of the executable units and their cycle time.

Take the execution time of an executable unit of type PCPGM from the *PC Elements - Advant Controller 55 Reference Manual*. The cycle time of a PCPGM is defined by the first call parameter (C1).

The execution time of an executable unit of type CONTRM, MASTER or SEQ consists of

- the execution time of the module header element CONTRM, MASTER or SEQ
- the execution time of all PC elements included in this executable unit
- the GET and PUT elements for the input and output phases.

You can find the execution time of all PC elements incl. the header elements in the *PC Elements - Advant Controller 55 Reference Manual*. If PC elements AND, OR, SR or XOR are executed in in-line code, you can find their execution time in Table 10-1. In-line code is automatically generated if two or more of those PC elements are arranged directly behind each other, without other types of PC elements in between. Note that for every in-line code sequence, the execution time of the in-line begin and end statements must be added.

*Table 10-1. Execution times for in-line coded PC elements*

| **Element** | **Execution time (in $\mu s$)** |
|---|---|
| AND | $1, 8 + 0, 8 \cdot C1$ |
| OR | $1, 8 + 0, 8 \cdot C1$ |
| XOR | 3, 5 |
| SR | 4, 4 |
| In-line begin+end | 5, 3 |

The execution time for a single PC element or for all PC elements within a module or block are automatically computable by means of an engineering station function. In-line coding of PC elements AND, OR, SR and XOR is not taken into account by the engineering station.

Every connection of a PC element terminal to:

- a DB element terminal or
- a terminal of a PC element within another executable unit

causes the execution of a GET or PUT element. If more than one PC element terminal within a certain executable unit is connected to the same DB element, only **one** GET or PUT element is executed.

The execution times of GET and PUT elements for connections to all kinds of DB element terminals are listed in the *DB Elements - Advant Controller 55* The execution times of GET and PUT elements for connections between PC element terminals in different executable units are listed in Table 10-2

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*Table 10-2. Execution times of GET and PUT elements for connection between different executable units*

| **Element** | **Data type** | **Execution time (in $\mu s$)** | **Notes** |
|---|---|---|---|
| GET | B,I,IL,R,T,TR | 8*n | n = number of connections of specified data type |
| PUT | B,I,IL,R,T,TR | 5*n | n = number of connections of specified data type |
| GET | A,G | (8+2*k)*n | n = number of arrays or groups<br>k = number of elements in array or group |
| PUT | A,G | (8+2*k)*n | n = number of arrays or groups<br>k = number of elements in array or group |

An executable unit including the module header element, PC elements, and GET and PUT elements is executed with the cycle time specified by the first call parameter (C1) of the module header element (CONTRM, MASTER or SEQ).

The CPU load $L_{exec}$ (in %) from all executable units can be calculated by the following formula:

$$L_{exec} = \sum_{i} \frac{N_i \cdot T_i}{C_i} \cdot 100\%$$

where

$T_i$ = execution time of function i (in ms)

$N_i$ = number of function i

$C_i$ = cycle time of function i (in ms)

Functions are

- the PCPGM
- module header elements CONTRM, MASTER, SEQ
- PC elements
- GET and PUT elements.

The cycle time $T_c$ is

- for the PCPGM, the own cycle time (call parameter C1)
- for a module header element CONTRM, MASTER or SEQ, the own cycle time (call parameter C1)
- for a PC element, the cycle time of the executable unit including this PC element
- for a GET or PUT element, the cycle time of the executable unit including this element.

## 10.2 CPU Load from MVI Data Block Communication

For a description of how to calculate the CPU load from MVI data block communication, see the manual *RCOM Advant Controller 55 User's Guide*.

## 10.3 CPU Load from Event Detection

Data base elements AIC, DIC configure event detection for PC signals connected to the terminal VALUE of these data base elements.

To every data base element AIC and DIC a system function is assigned which executes event detection. The CPU load from these event detection functions is determined by their execution time and cycle time.

The execution time of the event detection functions, depending on the kind of data base element, is listed in the manual *DB Elements Advant Controller 55 Reference Manual*. The cycle time of these functions equals the scan time for event detection (specified by the terminal SCANT).

The CPU load $L_{event}$ (in %) from event detection can be calculated by the following formula:

$$L_{event} = \sum_i \frac{T_i}{S_i} \cdot 100\%$$

where

$T_i$ = execution time of event detection function i (in ms)

$S_i$ = scan time of event detection function i (in ms), see terminal SCANT

## 10.4 Calculation of total CPU Load

The total CPU load $L$ can be calculated by the following formula:

$$L = L_{exec} + L_{MVB} + L_{event}$$

where

$L_{exec}$ = CPU load from executable units (in %)

$L_{MVB}$ = CPU load from MVI data block communication (in %)

$L_{event}$ = CPU load from event detection (in %).

CAUTION

**Twenty (20) percent** of the CPU load must be reserved for basic system functions. The remaining 80 percent of the CPU load is available for the application program.

# 10.5 Example

As an example, the CPU load of a short application program is calculated. The calculation of the load for the PCPGM executable unit PC1 is shown in Table 10-3, and for a CONTRM executable unit PC1.1 in Table 10-3 .

*Table 10-3. Calculation of CPU load for executable unit PC1*

| Function | Number of functions $N$ | Execution time $T_e$ (in $\mu s$) | Cycle time $T_c$ (in ms) | Load $L$ (in %) |
|---|---|---|---|---|
| PCPGM | 1 | 690 | 20 | 3,45 |

*Table 10-4. Calculation of CPU load for executable unit PC1.1*

| Function | Number of functions $N$ | Execution time $T_e$ (in $\mu s$) | Cycle time $T_c$ (in ms) | Load $L$ (in %) |
|---|---|---|---|---|
| CONTRM | 1 | 690 | 20 | |
| AND | 1 | $7 + 2,5 \cdot 3$ | | |
| GET(1) | 1 | $7 + 4 + 4 \cdot 5$ | | |
| PUT(2) | 1 | $18 + 4 + 2 \cdot 5$ | | |
| | | 767,5 | 20 | 3,84 |

(1) Four connections to DI610 channel elements or AC 55 DI channels (see *DB Elements Advant Controller 55 Reference Manual* or *DB Elements Advant Controller 100 Series Reference Manaul)*

(2) Two connections to DO610 channel elements or AC 55 DO channels (see *DB Elements Advant Controller 55 Reference Manual* or *DB Elements Advant Controller 100 Series Reference Manaul)*

The CPU load of the whole application is 3,45+3,84=7,29%.

# Chapter 11 Loading of AC 55 System Software

The Advant Controller 55 system software is stored in Flash PROM on the CT 481 or CT 482 basic unit.

The load system software into that Flash PROM. AS 100 ES the diskette listet below will be needed.

| | |
|---|---|
| • AC55 BASE SW*1.x | Base system software |
| • AC55 OPT1 SW*1.x | enables the extended PC element set |

The diskette contains:

- a loader program
- a file README.* which contains the latest information about the software
  a. possible other required software

## 11.1 Proceeding

The proceeding for loading an Advant Controller 55 system software is:

1. Put the CT481 or CT482 start mode switch into STOP position 1
2. Press the INIT button of the CT481 or CT482 basic unit
3. Wait until the lower right group of 8 LEDs of CT481 or CT482 shows:.

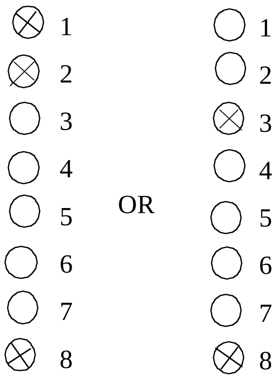

*Figure 11-1. Diagnostic display of CT481 or CT482*

4. Connect the tool to the Advant Controller 55 (see section 3.3)
5. Start the tool
6. Put the floppy disk containing the system software and the loader into the tool's drive A

7. Call the tool function „ Extemal Software"
8. You will be asked whether you want to overwrite the old system software
9. After having succesfully locaded the Advant Controller 55 system software this will be indicated on the tool's screen.

If there should be an error during the download of the system software, the above procedure must be repeated.

## 11.2 Loading an Option

Follow this procedure to load an AC 55 system software option:

10. Put the CT 481/482 start mode switch into STOP position.
11. Press the INIT button of the CT 481/482.
12. Wait until CT 481/482 display is according to Figure 11-1 above.
13. Connect the engineering station to the serial channel 1 of Advant Controller 55.
14. Start the engineering station.
15. Put the floppy disk containing the system software and the loader into the engineering station's drive A.
16. Call the engineering station function "Execute External Software."
17. You are warned that the loading process will terminate all currently running processes on the CPU.
18. When you have successfully loaded the option, it is indicated on the engineering station's screen.

If the option loading process is interrupted by either pressing the INIT button or a power failure, the system software and any previously loaded options are erased and must be loaded again.

This state of CT 481/482 is indicated on its display by showing the four lower LEDs 5-8 on and the four upper LEDs 1-4 off.

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